COMPRESSED AIR MAGAZINE

DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

Vol. xxiv JANUARY, 1919 No. 1

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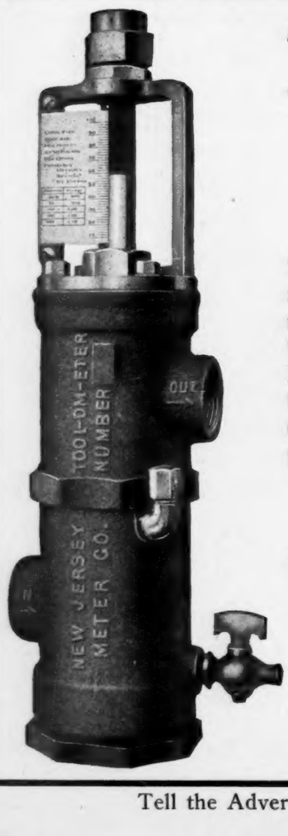

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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Vol. xxiv JANUARY, 1919 No. 1

PEACE AND WAR TEACH AND HELP EACH OTHER

How a great governmental agency engaged in saving the lives of miners and promoting the welfare of the industry, at the call to arms was instantly turned into an engine of death and destruction to enemies, is detailed in the annal report of the Bureau of Mines, Department of the Interior, by Van. H. Manning, the Director.

The report, which closes with the fiscal year June 30, while the United States was still at war, tells of the strenuous part played by the Bureau of Mines in assisting to build up the terrifying machine of death that would not have been felt with its fullest force by the Hun until the following spring. With the cessation of war the Germans, it is said, will never be able to realize what the full force of America's military might would have been, or the many devices and methods that were the result of American ingenuity, for the War Department is keeping the best of these a profound secret.

LESSONS OF THE WAR WILL SAVE MINER'S LIVES

At the same time great good for the future peaceful pursuit of industry in this country and for the saving instead of the killing of men has come out of this welter of death-dealing experiments, is the claim of the Bureau of Mines. Certain experiments with delicate instruments known as microphones and geophones, in order to detect the direction and the distance of enemy mining work in tunneling and the location of enemy artillery no matter where placed, has disclosed that these same instruments can be of use in determining the location of men entombed in mines following disaster. It is expected that, if the men have the presence of mind to make even a slight noise, the rescuers listening with these devices will be able at once to locate the men and begin the rescue work. Men thus entombed have been known to live for a week or longer under such circumstances, the rescuers being unable to find them. Other men have died before they could be located. The bureau will equip its rescue cars as soon as possible with these devices.

WAR EXPERIENCE TEACHES COAL SAVING

The war experience of the bureau is going to help peace industries in still another direction. The coal experts, eager to do their share in winning the war, were assigned to the testing of boilers to be used in the ships of the Emergency Fleet Corporation. Speed and the saving of coal were demanded. The result was that the experts so changed the design of the boilers that the coal heretofore necessary to send the ships along for six miles was sufficient to carry them seven miles. This great saving will be available in peace times.

Early in the war every experiment station of the bureau in the mining districts of the country at once closed its peace activities and marshalled for war. The entire bureau and its men and equipment were offered to the two war services. Especially pressing scientific problems were allotted to the different stations, and where the bureau did not have all the men necessary, it turned over its laboratories and equipment to the men assigned by the War and Navy Departments. In this way a central-control laboratory for the testing of materials of war was established at the Pittsburgh station of the bureau by the Ordnance Depart-

ment. Steel for cannon, material for cartridges and other materials used by the Ordnance were here tested for flaws and weaknesses. The War Department was determined that no soldier, in the emergency of battle, would be able to say that his gun failed him because of faulty material.

The War Department next seized upon the opportunity of using the bureau's explosive station and bomb-proof a few miles from Pittsburgh and there many important, yet secret tests into the action of new and deadly explosives, were made under the supervision of the bureau's and armies' experts. Information of the greatest importance to the warmaking powers was obtained.

GAS DEVELOPMPNT

Early in February, 1917, when war between the United States and the Central Powers seemed inevitable, the bureau offered its services in the study of poisonous gases and gasmasks to the War Department which was accepted. This was the beginning of the great organization of 1,700 chemists who constituted the Chemical Warfare Service at the American University at Washington and whose jurisdiction was afterwards turned over to the War Department. The bureau claims that as a result of its work, the United States was months ahead of where it otherwise would have been and the soldiers all had gas-masks of such quality that the War Department some time ago issued a statement to the effect that the gassing of a soldier was to be considered in the future as a matter of ignorance. Still further it is claimed by the bureau that through the energy of its research organization, the large-scale production of toxic gases was far ahead of the supply of shells.

Through its investigation of natural gases the bureau with the cooperation of the Army and Navy conducted important work relating to balloon gases. This work included the development of certain products for use in balloons that can be obtained from natural gas. No more can be said about the work at this time.

WAR MINERALS

It was soon found that there would be a tremendous demand by the military authorities for the so-called war minerals. With the havoc wrought by the submarines, the world was short of shipping and the United States was informed that these minerals should come from American mines, many of which were either inadequately developed or not developed at all, because this country had been depending on foreign sources of supply. The bureau was called upon to furnish these minerals and within a few months there had been developed a sufficient quantity of some to supply all war needs and a surplus of others. It is now said by the bureau that the metal mining industry has received such an impetus by this war demand that it will be in peace times a much greater and more prosperous industry than ever before. "America has been discovered by Americans," said Secretary Lane when he heard how the industry had responded to the war call.

LIQUID OXYGEN EXPLOSIVES

Whatever may be our confidence, or lack of confidence, in the ultimate extensive employment of liquid air or liquid oxygen for mining explosive, we cannot fail of interest in the experiments and developments in that direction. From the beginning of the World War military necessity compelled the German authorities to requisition the entire stock of nitric explosives. This created an emergency which gave Oxiliquit its opportunity, and a sketch follows telling a little about what is being done and how it is done in the employment of liquid oxygen for explosive service in mining.

The explosives which have come into almost universal employment for both military and industrial purposes are generally mixtures or definite compounds containing two essential constituents: a combustible element, carbon, and an ignition element, oxygen. The explosion is the result of the abrupt and violent combination of these two elements.

Oxygen is introduced under the form of nitric combination (nitric ether, nitric derivatives, nitrates) or chlorinated combination (chlorates of perchlorates); carbon in form of an organic matter (cotton, phenol, toluene, etc.). It is therefore easy to see that in ordinary explosives the combination of the active elements carries with it a considerable dead weight, constituted by the other elements (nitrogen, chlorine, potash, etc.).

It is not so with oxyliquit; here the liquefied oxygen is put in contact with carbon in a divided and porous form. Under a system

of ignition the combination takes place with explosion, and in principle the procedure is perfect. In the evolution of this process, however, which was first invented by Linde in 1895, many difficulties were encountered.

Liquid oxygen is always produced on the spot where it is to be used, as it is impossible to keep it very long, notwithstanding all the precautions taken against volatilization. It is prepared by liquefying the air, the mixture so obtained of liquefied nitrogen and oxygen being submitted to a partial distillation, which eliminates the larger part of the nitrogen, more volatile than the oxygen. The resulting bluish liquid contains about 85 per cent. of oxygen.

The German society for the exploitation of the Linde patents is able to furnish installations giving an hourly output of 10 kg. (23 lb.) of liquefied rectified oxygen. The price would be about 25 centimes per kilogram, including amortization and interest on capital invested.

To transport the liquefied oxygen from the place of production to the place of utilization, mine or quarry, a new container was necessary.

In the laboratory, glass vessels, socalled "Dewar" bottles, having double walls with a vacuum between, have been used for the keeping of liquefied oxygen. These bottles are not closed—on account of the danger of a closed bottle in handling—but, thanks to the good insulation, the loss of oxygen by evaporation is very small (about 50 grammes per hour, or 17.5 oz.).

These glass bottles, easily breakable, are not convenient for wholesale manufacturing nor for use in the workshop. They are now replaced by containers of metal—especially brass and steel—and these give excellent service.

The steel or brass bottles do not hold the vacuum as well as those of glass—being more porous—and the vacuum must be often renewed. To lessen this inconvenience, Dewar inserts between the walls very porous charcoal.

When the vacuum is made and the bottle filled, the annular space between the walls takes a temperature of—190° C. (—372 F.) the normal boiling point of the liquid, and the charcoal gets extremely porous and absorbs

Fig. 1

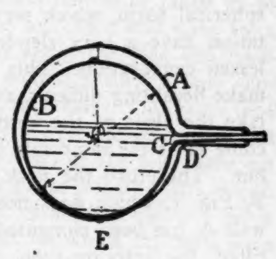
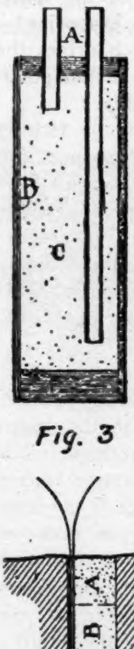


Fig. 2



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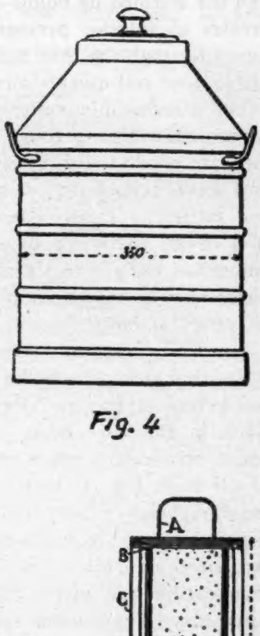


Fig. 4

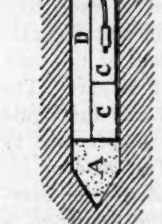


Fig. 5

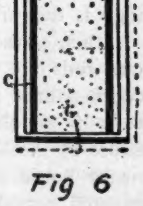


Fig 6

LIQUID OXYGEN PRACTICE

with great avidity the little gas that passes through the pores of the metal. The insulation power of the receptacle is well main-

tained for a long time. The containers, of a spherical form, which serve for the transportation have a very slender neck in order to lessen evaporation. This slender neck would make decanting difficult, as the air which must take the place of the outflowing liquid cannot come in at the same rate of the liquid coming out. Therefore the neck of the inner bottle B, Fig. 1, which does not touch the external wall A, has been elongated; when the bottle is tilted, the interior tube, long and with thin walls, is bent; the inner bottle touches the outer at D and E, Fig. 2; the insulation is interrupted; there is a warming up of the space, and the warmed up liquid—partly evaporized—creates an interior pressure which drives the liquid through the thin neck. It is thus possible to pour out quickly and steadily.

The combustible material must be rich in carbon, and also porous, so as to come into intimate contact with the liquid oxygen. Several have been tried; a mixture of gasoline and infusorial earth (Kieselguhr), in proportion of 40 to 60; a dry wood pulp; finely pulverized cork; dried peat; lampblack. This latter showed its unqualified superiority over all other material.

USE OF CARTRIDGES.

By what is known as the Kowastsch method, the liquid oxygen is poured upon the lampblack in the bore hole. A cylindrical cardboard cartridge is made of the same diameter as the hole, Fig. 3; this cartridge B contains the lampblack C, or other porous material rich in carbon. It is closed at both ends with cardboard or cork. Two small tubes A, of thin cardboard, pierce the stopper at the outer end. These tubes serve for the pouring of the oxygen, also for the ignition system (fuse or electric). The cartridge being thus made, a metal rod is inserted in each tube to prevent them being crushed, and the cartridge is deposited at the bottom of the hole. It is then packed with a wad of clay. The metal rods are then extracted and the liquid oxygen poured in through the larger tube by means of an elbow funnel. The gaseous air escapes by the shorter tube, and also the overflow of liquid oxygen when the cartridge is saturated completely. The cartridge is now ready for the firing. The explosion is comparable to that of dynamite.

The Marsit method allows of a more regular working; it is therefore more in use than the other. Here the cartridge is saturated before being introduced into the bore-hole. To do this the cartridges are immersed in a special vessel of cylindrical shape with double walls, filled with liquid oxygen, Fig. 4. The cartridges are left first exposed for a few minutes to the vapors above the liquid to cool them off, then completely immersed for half an hour. The saturation is therefore complete. When the cartridge is saturated it is taken out and the ignition system attached as quickly as possible. It is then placed in the bore-hole and tamped, Fig. 5, and exploded.

The manipulation in this method is far simpler than in the first mentioned. The only inconvenience is the unavoidable delay between the taking out of the cartridge and the placing in the bore-hole. During the lapse of these few minutes a certain part of the oxygen of the cartridge evaporates. To lessen this loss and to keep in the lampblack a sufficient excess of oxygen, the walls of the cartridge are made watertight; they are of corrugated cardboard. Fig. 6 shows this cartridge, called the Messer cartridge, which is very much in use. This make-up explains the long duration of the immersion. But in this way the cartridges keep their strength for 8 to 10 minutes after they are taken out of the liquid oxygen.

There is no need of a detonator to explode these cartridges, and this is one of the advantages of the new method; all that is necessary is a small primer ignited by a fuse or by electricity.

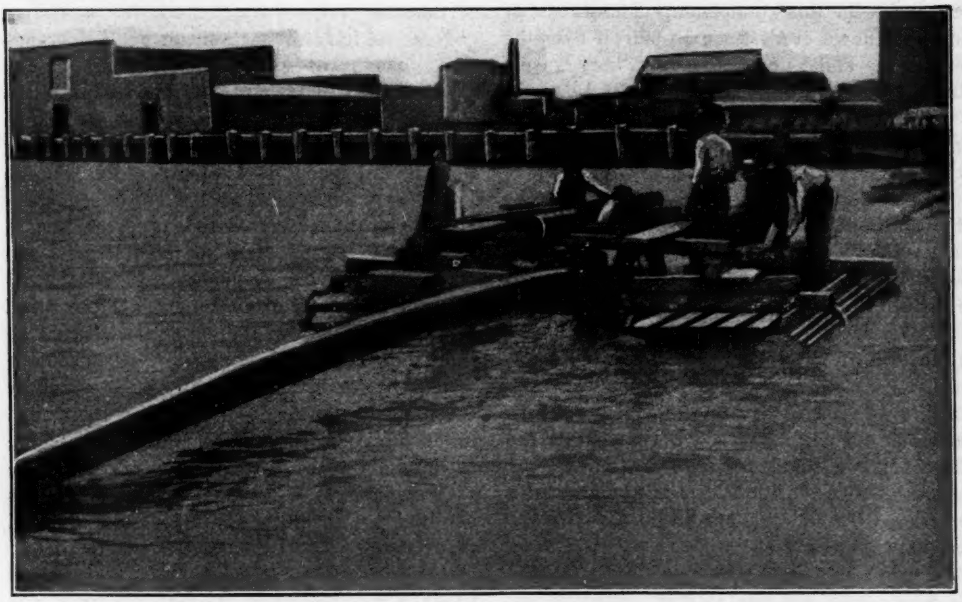
PRACTICAL RESULTS.

The principal company manufacturing oxyliquit, the Sprengluft Gesellschaft, m. b. H., of Berlin, claims to have delivered each year an equivalent of 10,000 tons of nitric explosives. Even allowing for probable exaggeration, that shows how widely this product is used in Germany. Its greatest advantage over other explosives is that it almost entirely eliminates the danger of accidents. The cartridge itself is explosive for about 10 minutes only, between the time of its saturation and the time of its ignition. During this time the danger is not any greater than with any other explosives. The result is that in case of a miss it is only necessary to wait half an hour for the cartridge to become entirely harmless, and then one can uncover the bore-hole without any

danger. What is more, all dangers inherent to transportation and storage of the explosive are entirely eliminated.

The method, however, has its inconveniences, the principal objection being that it is impossible to store liquid oxygen, necessitating the establishment of a liquefaction and rectifying plant at the place where it is used. Also there is need of very experienced hands for a quick charging of the boreholes.

Theoretically the new explosive can claim superiority over others. In practice, however, it gives an explosion hardly equivalent to the most powerful explosives known, the common dynamite and the gelatine-dynamite.



WELDING ON A RAFT

WELDING A GAS MAIN

The Pacific Coast shipyard of the Bethlehem Shipbuilding Company is on an island in San Francisco Bay, separated from the mainland by a navigable channel spanned by drawbridges and for a gas supply it was necessary to lay an 8-in. pipe in a dredged trench 40 ft. below the water surface. There were two 700 ft. welded lengths of pipe available for the purpose. These two lengths were welded together, the ends were tightly closed to take advantage of the buoyancy and it was pulled across the water. The line was then allowed to fill and it settled down into the trench. Soon after the pipe was placed a section was broken out by a ship so that it had to be taken up to have a piece welded in. This was done by a diver placing chains about the pipe and leading them up to be wound around a pipe supported by barges on each side. This cross pipe above was turned by big pipe tongs and served as a windlass. The ends of the pipe were cut off with the oxy-acetylene cutting torch, which was a most difficult task when passing boats would rock the rafts on which the men were working, and the same difficulty was encountered in the rewelding. The welder found it very difficult to keep his torch and metal at the point of the joint. The job was done successfully, the pipe was tested and lowered again to its place and is now in use. The halftone gives a general view of the operations.

INSTRUMENTS FOR AIR USE*

Let us take a look into an airman's office. I do not refer to the wooden hut on the ground where in bad weather cigarettes are smoked, the illustrated weekly papers read, and aerial operations discussed in professional slang.

I mean the "office" where the pilot does his real work; and this is the name which for some inexplicable reason has been given to the

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*By Lieutenant William A. Robson, R. A. F., Author of "Aircraft in War and Peace."

cockpit of an aeroplane, wherein sits the aviator. To the uninitiated it appears a confused medley of dials, recording needles and levers; mysterious, unfathomable, exciting. But to the trained airman these things are as an open book; and each one of them is in some way essential to the control of the machine and its manœuvres.

The most important of the instruments is the compass. Without its aid an airman who is flying over the sea or over land on a misty day is hopelessly lost. In the R. A. F. great attention is attached to the necessity for every pilot being able to fly a compass course; that is to say, a course along which he is guided solely by his compass; and very great progress has been made in this connection. Thousands of miles are flown every week on patrols over the sea alone, and pilots nowadays very rarely come to grief through losing their way.

This is saying a good deal, when the problem presented by draft is remembered. If an aircraft starts from one point to fly to another due east, and there is a wind blowing at 15 miles an hour northeast, that will clearly have to be taken into consideration, and the compass course altered (before ascending) according to the total distance of the journey.

Many difficulties had to be overcome in the production of a satisfactory compass for aerial work. Chief among these was that of neutralizing the magnetism of the engine (and in particular the magneto) and of preventing the effect of centrifugal force, which caused the card or dial inside the compass to swing in a direction quite independent of north when the aeroplane was banking on a turn. However, a truly excellent compass is now in use in the R. A. F., far superior to that employed by the enemy. And indeed it would be odd if the Germans should have proved able successfully to compete in this direction with a nation whose commerce for several hundred years has been largely dependent on the excellence of its ships' compasses.

Probably the next most important instrument is the aneroid or height indicator. This is worked on a simple mercury principle, and is generally fitted with an adjustable dial which can be moved round so that the reading on leaving any given aerodrome is zero. Which reminds one of rather an amusing occurrence. A pilot left his aerodrome for a cross country flight on a very misty day, and carefully set his aneroid to 0. After flying for a couple of hours by compass he thought he must be nearing his destination. He could see nothing below him and so descended to 500 ft. On he flew at this height for another five minutes. Deciding to land, he was about to make a magnificent volplane, when suddenly the mist cleared and he saw ground immediately underneath him, about 10 ft. below. His fathful aneroid still insisted that he was 500 ft. high. The explanation lay in the fact that the place he was about to land on was 500 ft. higher above sea level than the aerodrome when he set out. Trifles like this are all in the day's work and help to teach the young pilot never to become the slave or dependent of mere instruments.

Next we have the tachometer or "rev. counter," which records the number of revolutions the engine is making per minute. This varies from about 1,100 (in rotary motors) up to 1,800 in water-cooled engines. The reading of this instrument is of great interest to the pilot, for modern aircraft are so carefully designed that their performance is affected enormously by even an extra 100 revolutions or so per minute one way or the other.

Another important instrument is the air speed indicator. This tells the pilot at what rate he is rushing through the air. This speed, of course, has no relation to the rate at which he is travelling over the ground. Nor is it intended to, for it is air speed which is of importance to the stability of the aircraft and the safety of the pilot. If a machine flying at 70 miles per hour is travelling against a 40-mile wind, the A. S. indicator will show 110 m.p.h.

Every aeroplane has a minimum air speed at which it must be thrust through the air if it is to be maintained aloft; and a maximum air speed in excess of which it cannot safely be nose-dived, for the various components will not stand the strain beyond a certain given point. It can be seen how essential is this device on a flying machine. Air speed indicators have been fitted to British aircraft for years past and it is interesting to note that the Germans have just commenced to use them.

The next item which calls for attention is the inclinometer. This is a curved spirit level fitted transversely across the machine. It is marked in degrees; and the pilot can tell from it at what angle he is banking his craft when turning.

With the addition of a miniature set of electric light clusters and a neat eight-day watch the list of instrumental equipment is concluded. The only remarkable feature of the watch is that if an aeroplane is left without a guard for five minutes after a forced landnig, the watch mysteriously disappears!

There are several pressure gauges on the dashboard. One for each petrol tank, to indicate the pressure at which air is forcing the spirit to the engine; and another one to show the pressure in lbs. to the square inch at which oil is being driven through the various lubrication channels. On water-cooled engines a thermometer records the temperature of the water in the radiator.

Space forbids a detailed description of the controls. However, it may briefly be said that there is a swivelling foot-bar for the rudder; while a central lever, commonly known as the "joystick" actuates the elevation and banking of the aeroplane. A wheel at the side increases the angle at which the tail plane "attacks" the air, this being for rapid ascension. Two side levers control the speed and petrol consumption of the engine.

Then come the various articles of military equipment. These comprise the machine guns with their actuating gear firing straight through the propeller, and controlled by a lever on the joystick; the wireless outfit in the observer's cockpit; and, finally, message bags, bomb sights, and camera release handles.

And some folk seem to think pilots are not very busy people!—*From Flight.*

PURIFICATION OF COAL GAS BY ELECTRICITY

By M. Meredith.

The deposition of tar and other impurities from coal gas by electrical means has recently been undertaken and satisfactory results have been attained. High-tension direct current is discharged between a cage made of thin wires and a tube, the system of wires being mounted in the middle of the tube. It is essential to prevent access of air to the precipitation chamber in order to avoid the danger of explosion. It was found that the tendency toward the production of harmful discharges is least if the wire electrode is negative. The shape of the electrode is highly important, and the sustaining insulators are specially formed and cemented into the tube. A ½-in. gas tube is passed through a series of cast-iron disks, between which the thin steel wires are fixed. The whole is then placed in a felt-covered tube, which constitutes the grounded electrode.

The apparatus was tested with a flow of 265,000 cu. ft. of gas per hour, two precipitation chambers 4 ft. 11 in. in height and 8 in. in diameter being used. Disks of the active electrode were 4 in. in diameter, and were covered with 16 thin piano-steel wires. The passage traversed by the gas was 12 ft. 4 in. long. The gas was exposed to the electrical discharge for 0.4 second.

After five hours' operation the tar deposited on the insulators was found to interfere with the action. For complete cleansing of the gas 0.2 kw.-hr. was required for each 265,000 cu. ft. The total cost of the apparatus was about $500. The test was made with 20,000 volts and a current of about 3 milliamperes.

The temperature of the coal gas has little influence on the operation. Tar deposited at 175 deg. F. is free from water and suitable for asphalting. It can be cleansed in a washing apparatus and the residue of naphthalene can be reclaimed by a second electric precipitation. The illuminating and heating capacity of the gas is improved if the tar is removed while hot.

THE GARAGE DANGER

With the advent of cold weather it may not be amiss to again revive the oft-repeated warning against running an automobile engine in a closed garage; although it is not likely that it will do much good, as there are always people who, if not entirely ignorant on the subject, will take a chance. The difficulty appears to lie in the impossibility of impressing a realization of how very little of this exhaust gas is necessary to produce fatal results, and inability of many people to understand that a gas that they cannot smell is dangerous. The gas you smell is that of incomplete combustion and from burnt oil; but the most dangerous gas has no odor, and the more perfectly the engine operates, the greater the quantity of the deadly gas. How dangerous it is may be appreciated from the fact that an amount as small as one-twentieth of one per cent. in the air breathed is sufficient to produce poisonous results.—*Scientific American.*

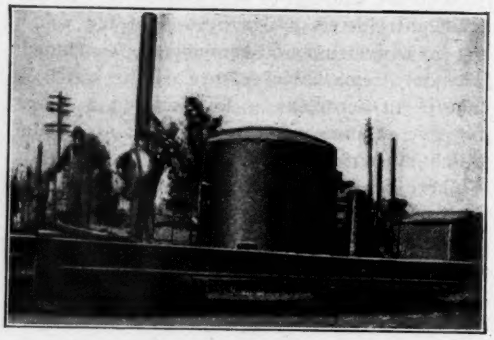
AVIATION SCHEMES

One great advantage of the war has been the forced development of aviation, and it is certain that a product of peace will, within a short period, result in the aeroplane becoming one of the most common and ever-increasing methods of long-distance locomotion for passenger, postal, private and commercial purposes. Ideas—possibly fantastic to the unimaginative and unknowing—are now being prepared in readiness for a wonderful future. "Witecraft" airlines, to encircle the globe and having a vast central aerodrome already in existence at Whitehead Park, close to London, is a proposition taking concrete form. The plan is designed to establish associated aerodromes in various parts of the earth to assist greatly in linking together the world's commerce. In regard to flights between England and America, Mr. J. A. Whitehead, of Whitehead Aircraft (1917), Ltd., takes a daring gaze into the future by hinting at the creation of flexible floating aero-stations in the Atlantic Ocean. These harbors for aircraft would be kept in position under their own power.—*Mining World*, London.

AIRCRAFT EVOLUTION

The United States War Department authorises the following statement of evolution in aircraft engines prepared by the National Advisory Committee: The first man-carrying airplane flights were made in December, 1903, with the Wright Brothers' engine, developing 12 horse-power and weighing 12.7 lb. per horse-power. In 1910, seven years later, the average horse-power of aeronautic engines had increased to 54, and the weight decreased to 5.7 lb. per horse-power. In March, 1918, the Liberty 12 developed 432 horse-power for a weight of 1.86 lb. per horse-power. By May, 1918, the Liberty 12 was yielding a maximum of 450 horse-power for a weight of 1.83 lb. per horse-power. The Langley-Manly engine, built in 1901, was nine years ahead of its time in the matter of power output, and sixteen years ahead in its weight per horse-power, developing 52 horse-power, and weighing 2.9 lb. per horse-power.

Italy is making arrangements for the transport of wounded soldiers by aeroplane. The Caproni machine, it is said, will carry ten to twelve stretchers.



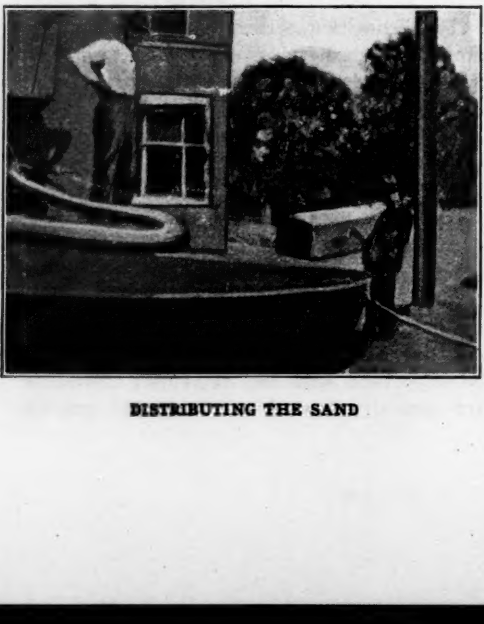
PNEUMATIC SAND CAR

PNEUMATIC SAND CAR FOR DENVER STREET RAILWAYS*

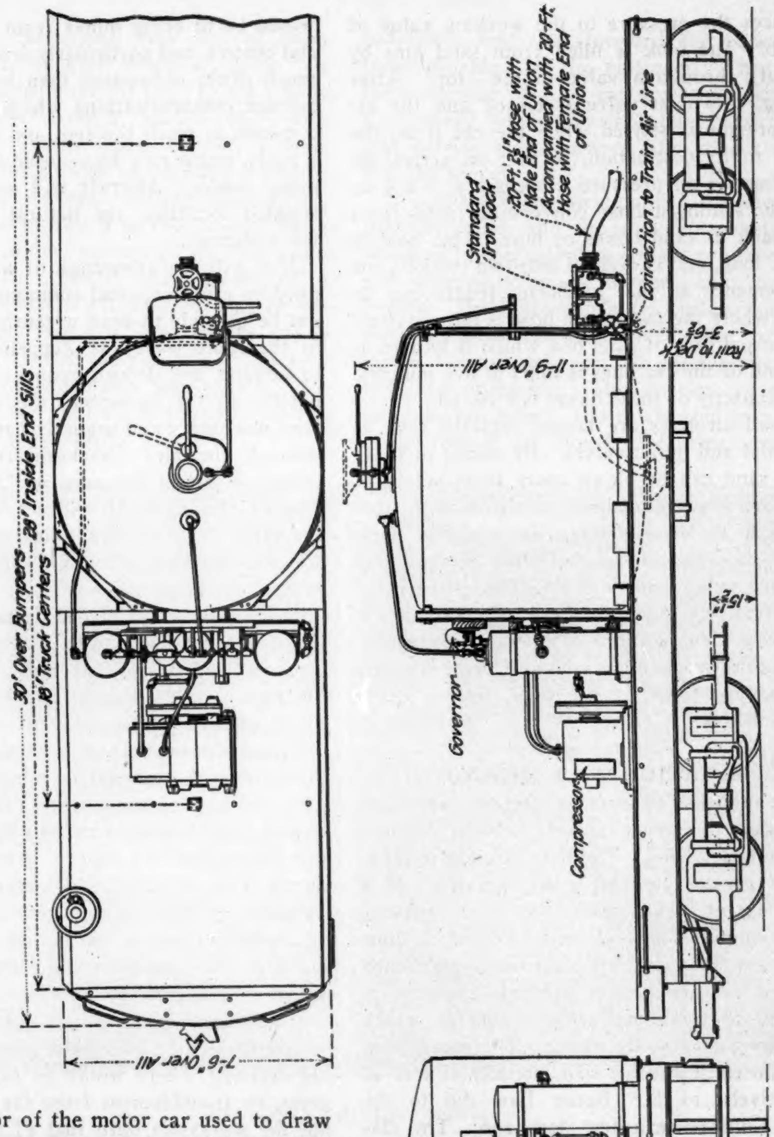
In the operating of street railways the distribution of sand to be used along the tracks, although perhaps a minor detail, is still a constant requirement. The scarcity and the increased cost of labor has led the officials of the Denver Tramway to develop and adopt the sand car here brought to the attention of our readers.

The car is 35 ft. long over all and has a steel underframing of 15 in. channels. It weighs 50,000 lbs. when fully loaded and 29,600 lbs. empty. The sand tank is 6 ft. by 7 ft. 6-in. in dimensions and has a net capacity of 8½ cu. yd., or approximately 10 tons. The air pressure used for unloading the sand is furnished by a D4K Westinghouse motor-driven air compressor mounted on the sand car. Air connections are also provided so that

*By W. L. Whitlock. Abstract from *Electric Railway Journal.*



DISTRIBUTING THE SAND



DETAILS OF PNEUMATIC SAND CAR

the compressor of the motor car used to draw the sand car can be used for helping out in the supply of the air necessary for unloading the sand. So far the only time that it has been found necessary to use the compressor of the motor car is when large storage bins are filled and the tank is emptied completely in one operation. The complete unloading can be accomplished in half an hour.

The compressor on the sand car is cooled by means of a water jacket. The necessary water supply is obtained from a storage tank mounted on the car. For unloading the sand 25 lb. air pressure is used. Three receiving tanks, two of which are 14 in. x 48 in., and one 14 in. x 33 in., take the air from the compressor at from 60 lb. to 75 lb. pressure. A reducing valve, installed between the last tank and the air connection to the top of the sand tank,

reduces the pressure to the working value of 25 lb. The tank is filled from sand bins by gravity through a valve in the top. After filling, this inlet valve is closed and the air compressor is started while the car is on the road to its destination, so that on arrival no waiting for air pressure is necessary. A 2½-in. rubber sandblast hose conveys the sand from the tank to sand boxes or bins. This hose is 40 ft. long, and is divided into two sections for convenience so that a shorter length can be used where the full length hose is not required. The usual type of sand box which is located at the end of the car lines is filled in five minutes. The capacity of these boxes is 1 cu. yd.

Small air lines are tapped into the tank at the inlet and outlet valves. By means of these lines sand can be blown away from valves in case there is any tendency of the sand to stick or pack at these points. In addition these hose lines provide an effective method for cleaning valve seats, which facilitates the valve operation. A motorman and a brakeman are the only men required to operate this equipment, thus producing a saving of three laborers and a large part of the time necessary for filling boxes.

AVIATION AND MINING

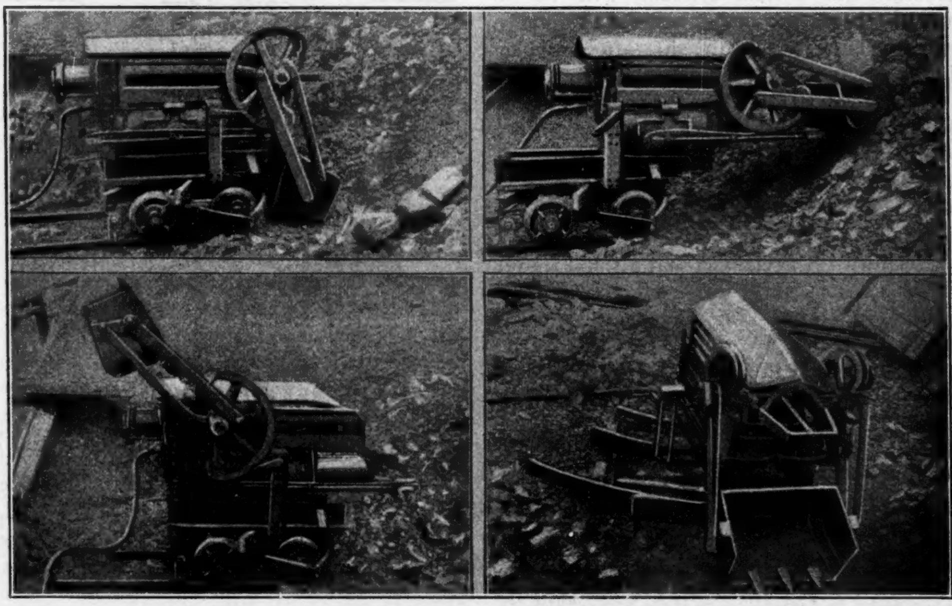
The influence of aircraft after the war upon the future of mining is likely to be of a potent and enduring kind. The help aircraft is capable of giving must facilitate operations to a great extent. Difficulties that were formerly insurmountable, save at the cost of much time, may now be overcome in greatly shortened periods. A manager is suddenly required to proceed to the mine, with respect to which something is radically wrong. The manager in question can fly to the spot, literally as well as figuratively, as Mr. Bonar Law did to the Paris Conference a few days ago. The distance the manager has to traverse may be greater than that covered by the Chancellor of the Exchequer, but it can be taken in stages, and early arrival may prevent much from happening that may be deleterious to the company's interest. This applies particularly to mines in isolated spots as yet uncivilized by railways, and only accessible by a fatiguing journey on horse or mule, extending, perhaps, over many days. From an air base, duly established, such a journey might be accomplished in a few hours, and the general effect would be to bring mines from great commercial centres, and particularly from London, into much closer connection than heretofore. Important communications which formerly took a month to reach the spot and a month to get a reply, might now be reduced to a limit of as many weeks. Aircraft will come to be, for isolated localities, the natural supplement of the telegraph.

Nor will the advantage of aircraft be confined to rapid personal communication. Will it not be possible to send urgently needed goods in the same way? If Zeppelins could carry to London, and deposit upon its streets tons of bombs, will it be beyond the wit of man to send machinery and urgently needed appliances through the air? Shakespeare foresaw the telegraph, when he says in "A Midsummer Night's Dream":—"I will set a girdle round the earth in 40 minutes"; just as he may have foreseen aircraft when he speaks, in "Macbeth," of being "horsed on the sightless couriers of the air." The vista that aircraft opens to the world, and to mining as part of it, is so all-embracing that one is lost in contemplation of the depths and heights—particularly the heights—to which it may attain.

Let us suppose that, in a distant country unprovided with railways, a mine needs a new part for one of the engines, or even a new engine itself, which can only be obtained in this country, where, indeed, it ought to be obtained if at all possible, for after the war, let us hope, we shall work together more closely as a people than we did before it. A British manufacturer provides the article required, and it is "shipped" by aircraft in stages, until the destination is reached—perhaps months earlier than could have been possible under the old *regime*. There would be rapidity of progress, no transhipment from the time of leaving the workshop until that of arrival on the mine—only arranged stopping places *en route* to obtain fresh power, and overhauling for the machine, with rest and recuperation for the crew. "Oh!" but some will say, "what about accidents?" But do no accident occur by railway, or at sea? Inventive genius has not said its last word with respect to aircraft, and, it will be a long time before it does.

Talking of the question of intercommunication, this need not be confined to the managers of mines. Directors might take a trip to see the property they are administering, which,

under present conditions, very few of them ever have done or ever dream of doing. It would be a spectacle for the gods to see a body of directors start from a London office, with the secretary in attendance, to visit a mine thousands of miles away, performing the journey in a flying machine. Indeed, we may expect at no distant date a qualifying test for a director to be his willingness to visit the property *via* the air. Before being re-elected, a shareholder, in meeting assembled, may be expected to ask—"Are you prepared to pay a literally flying visit to the property?" to which the director would suitably reply—"Yes, provided that the fee paid me be proportionate to the risk!"—*Mining World,* London.



PNEUMATIC MINING SHOVEL

THE ARMSTRONG MINING SHOVEL

The enormous quantities of material now handled by steam shovels in open cut mining has enforced the necessity for a similar machine for underground work and this has led to the development of the ingenious and effective Armstrong air operated mining shovel here shown in a group of photos reproduced from a recent issue of *Engineering and Mining Journal.*

The shovel consists of three principal parts: A truck suitable to the gage of the mine track; a platform that permits lateral swing, and a body-piece that rolls forward and back on a track provided by the platform. The body-piece consists of four cast-iron cylinders and a crosshead, which travels in horizontal guides and carries rope sheaves, the dipper arms, and the dipper.

In operation, the swinging of the shovel is done by hand, and the shovelling motion is obtained by the cylinders, which use direct air and requires no gears, clutches, belts, or conveyers. The bottom cylinder pushes the body piece forward, the center cylinders turn the dipper through 90°, and the top cylinder pulls back the crosshead. This carries the dipper up and over, where it is discharged into a car at the rear of the shovel. Simultaneously, the bottom cylinder pulls the body-piece to the rear, and this reversal brings the dipper back to the starting position in the front of the shovel. Each of the center cylinders is provided with a plunger piston, the center of which is bored and contains a stationary piston anchored by a rod to the back head, the space inside this latter piston being partly filled with oil. The effect of this arrangement is to limit the speed of the digging part of the stroke. This is necessary when the dipper strikes a solid piece of rock and the resistance causes a temporary building up of air pres-

sure behind the piston. Without this provision the dipper, in sliding to one side of the obstruction, would be thrust suddenly forward, causing all the dirt to be thrown out.

The bottom cylinder which crowds the body-piece forward and pulls it back is smaller than the center cylinders and exerts a forward push at the point of the dipper-lip of about 1,200 lb. The pressure given by the center cylinders is 3,600 lb., so that if the dipper catches on solid ground, the push of the center cylinders will overcome the forward thrust of the bottom cylinder and thus force the body-piece back until the dipper clears the obstruction. Then, owing to the oil control, the dipper will move up slowly, while the bottom cylinder, with no oil control, shoves the body-piece ahead quickly, burying the dipper in the dirt after clearing the obstruction.

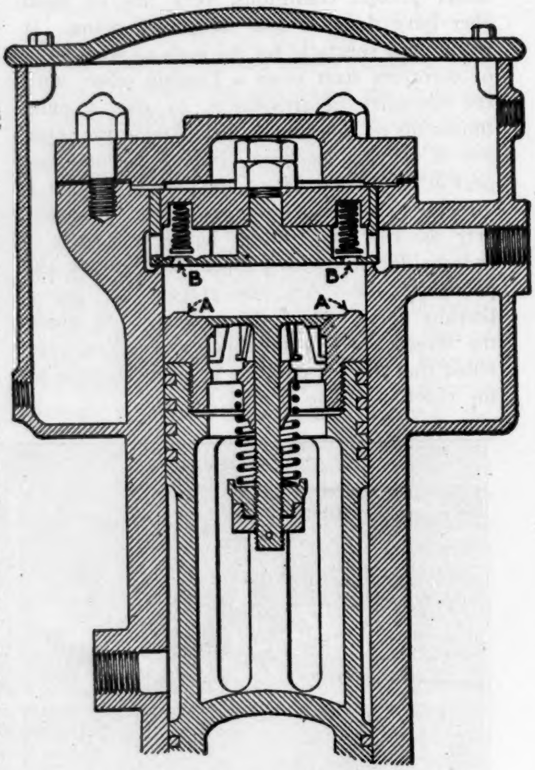
The shovel is 6 ft. long, 4 ft. wide and 4 ft. high, and on the upper extension allows headroom of 6 ft. 8 in. above the top of the rail. The swing allows a clean-up 9 ft. The daily capacity depends not upon the machine itself but upon the rapidity with which cars are supplied. It is claimed that a small shovel loaded 105 tons in seven hours at the plant of the American Zinc Company, Mascat, Tenn.

The shovel is built by the Armstrong Shovel Company, Vulcan, Mich., F. H. Armstrong, president and general manager.

DEEP MINING ON THE RAND

The lowest workings on the main incline from the Turf Mines shaft of the Village Deep have now reached sea level, i. e., 5,633.69 ft. vertical, which is the greatest depth at which mining is now done on the Rand. All the natural obstacles to working at this depth have been successfully overcome. The rock pressure has proved the chief obstacle, but this has been countered by the special methods of support adopted. The increased heat has likewise been offset by adequate ventilation.—*Sou. Af. Min. Journal.*

The highest reading ever attained by the barometer in New York City, according to Weather Bureau records, is 30.93 inches; the lowest, 28.61 inches.



SECTION OF CYLINDER

HIGH SPEED COMPRESSOR

The accompanying cut shows the essential features of an air or gas compressor designed to be direct connected to an oil or gas engine and consequently to be run at high speed, which of course means large capacity for size of unit. There may be two, three, four or even six cylinders similar to the one here shown in section all connected to a single crank shaft below. The special feature to which attention is called in this machine is the elimination of clearance at the termination of the stroke, which will be self-evident from a look at the drawing. The air is admitted by a valve in the trunk piston, the valve when closed being flush with the flat top of the piston. The flat top of the piston travels close to the flat face of the cylinder head above. Upon the flat face of the piston there is a ring projection A which enters and fills the annular valve pocket B in the head. The compressor is built by the Niebling-Markstein Company, 201 Bell Block, Cincinnati.

TESTING A NEW BREATHING APPARATUS

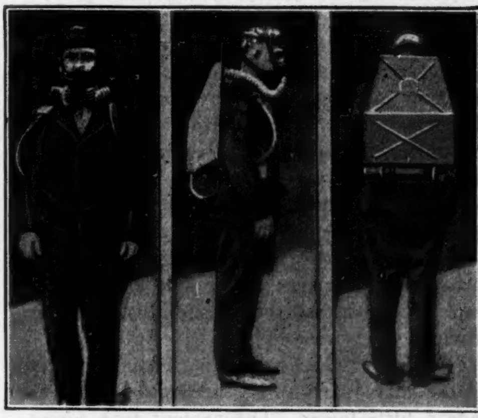
By John Lyons.

In order to test the new Gibbs standard two-hour breathing apparatus a number of employees of the Madison Coal Corporation on October 4 last journeyed by automobile to the Illinois state mine rescue station at Benton, Ill. The party was composed of William Turton, district superintendent; John Lyons, rescue foreman; Herschel Harriss, assistant mine foreman; John Lauder, face boss, and Fred Schoonover, safety inspector.

These men were well received by James Weir, superintendent in charge, who clearly described the different types of safety lamps and rescue apparatus kept at the station. The new Gibbs apparatus was explained and the machine thoroughly tested for leakages, careful note being made of the amount of oxygen contained in the cylinder at the start of the test and the amount used in a given time.

John Lyons was the first to wear the machine, the gage at this time showing 135 atmospheres. He performed work in the smoke gallery, such as pulling the 50-lb. weight, sawing props, crawling through the 17x19-in. tunnel, carrying a 130-lb. dummy single-handed round the gallery and then carrying the body end of a stretcher bearing a 160-lb. man with another man carrying the foot end. Lyons worked as fast as possible, not stopping at any time to rest. Unfortunately no record was kept of the actual work done. At the end of 30 min. the apparatus was taken off. The gage now read 75 atmospheres, showing that during the work-period of 30 min. 60 atmospheres of oxygen had been used, or almost one-half the capacity of the cylinder when fully charged. This amount equals 116 liters, or an average of 3.86 liters per minute for the 30 minutes.

Without recharging, Mr. Harris at this point put on the apparatus, with the gage showing 75 atmospheres. A correct record was kept of the work performed by him, which was as follows: Trips around gallery (100 ft. per trip), 29; pulled 50-lb. weight 3 ft. high 90 times; pushed pit car a distance of 60 ft. 16 times; carried 130 lb. dummy single-handed 360 ft.; sawed props 4 in. in diameter with dull saw once; went through a 17x16 in. tunnel once. The total time occupied during this work was 30 min., and the total amount of



GIBBS BREATHING APPARATUS

oxygen used was 40 atmospheres, or 77 liters, being an average of 2.56 liters per minute.

Mr. Schoonover then put on the apparatus without recharging, the gage reading 35 atmospheres. He walked round the gallery for 10 min. and was then forced out because he had no oxygen in the cylinder. The gage readings showed that he had used 35 atmospheres in 10 min., equal to 67 liters, or at the rate of 6.7 liters per min. Undoubtedly there must have been something wrong with the gage, causing it to register more than the cylinders actually contained. No person under any condition, no matter how hard the work, is capable of using up so much oxygen. Experts consider that 3 liters per minute would be the maximum quantity used in hard work.

Special attention was given to the behavior of the automatic feed valve on the apparatus, which is said by the makers to allow sufficient oxygen to the wearer no matter at what speed he may be working, and to reduce the quantity passing when the wearer ceases work or rests; also the temperature of the inhaled air from the breathing bag. The three wearers all agreed on the following opinions:

That at no time did they have to slacken their speed because the automatic valve was not delivering sufficient oxygen, enough being supplied at all times.

While the purifier got so hot that it could not be touched with the bare hands, the temperature of the inspired air did not seem to rise perceptibly throughout the trials.

At no time did the breathing bag get so full as to make it uncomfortable to breathe against.

This is brought about by the automatic release valve, which releases the air in the breathing bag when it reaches a certain pressure. However, it was thought that owing to this valve releasing easily it might have been the cause of using up such an excessive amount of oxygen during the period of 70 min. in which the apparatus was worn.

The center of weight of the apparatus is too high on the back, causing the person wearing it to have to lean forward in order to maintain its balance. A glance at the side view photograph accompanying this article illustrates this clearly.

It was also thought that the casing that covers the main part of the apparatus could be made a little lower. The present type comes too much in contact with the wearer's head when he bends down for such work as pulling the weight.

There should be some different arrangement for holding the gage when this is not being read. The wire clips now in use allow the gage to jump out when the wearer of the apparatus is using a saw or pulling the weight machine.

The foregoing trials were made with men well trained in the use and care of mine-rescue breathing apparatus. They are members of the rescue brigades which are maintained by the Madison Coal Corporation at its Carterville mines. These brigades have helped the state teams at explosions occurring in the southern Illinois coal field during the last four years, including the recent disaster at Royalton.

ICE IN AIR PIPES

By *A. A. M.*

Every plant using compressed air is troubled with ice forming in the pipes or machines during cold weather. On ship work, which is generally conducted out of doors, this trouble may cause a complete shutdown. Although various remedies have been applied by the different yards, there seems to be no generally accepted plan for eliminating this trouble. In considering a remedy, the cause should first be determined. Of course, if there were no water in the pipe, or if the temperature were maintained above freezing, there would be no ice, regardless of the water content.

One of the eastern yards found that during cold weather the air drawn from the low points on the line was more like a spray of water than a jet of air, and that in a few minutes ice formed in the hose or in the contracted passages of the lines or machines and cut off the pressure, with the result that considerable time was lost daily. As a remedy, a pipe coil that had been used for heating was connected to the line and a fire built on top of it. Although the air passing through this coil was raised to a high temperature, after it had passed through fifty feet of the hose it would freeze again. Owing to the lack of mechanical care in the application of the heat, a fire sufficient to maintain steam in a 10-horsepower boiler was not able to deliver warm air to the machine; besides, the air compressor was taking air from inside the engine room, where the worst possible conditions existed both as to the amount of water contained in the air and the economy of compression. Lowering the temperature of the intake air 50 degrees increased the amount of air delivered to the pipes about 10 per cent.

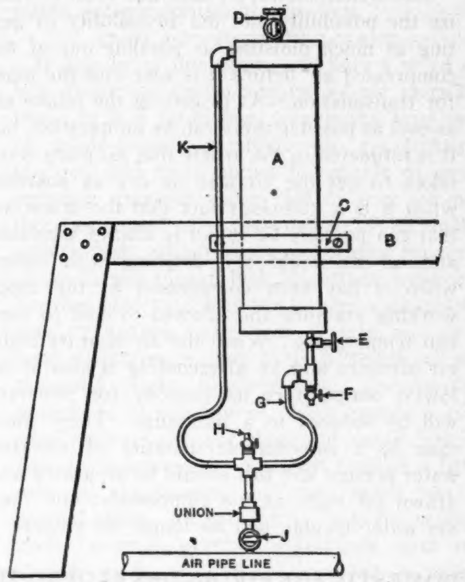
In another yard, a small cast-iron manifold was made in which a steam jacket surrounded the air passage. While the air passing through this manifold was heated successfully, it cooled very rapidly after entering the air line. By placing a steam covering on the air hose, warm air was delivered to the machine, but sometimes the hose was burned; furthermore, the expense of maintaining a steam line out of doors to remote parts of the yard was a large item, so that other methods of heating were tried. In one of these, manifolds were placed in the top of sheet-iron pots, in which coal fires were kept burning. For use inside the ships, some manifolds were rigged up and heated by kerosene blow-torches and the shortest possible hose connection was placed between the heater and the machine.

Nearly all shipyards have used alcohol in the air-pipes in some way or another. One yard places five gallons of alcohol into the main receiver at one time. For a while there is perfect freedom from ice throughout the line, but this plan involves the shutting down of the air-compressor for several minutes, and, at best, is not effective for more than an hour. In some other yards, the injection of the alcohol is left to the individual initiative of the machine users. When a man becomes impatient from the delay, he obtains an order from his foreman to procure the alcohol from the

storehouse; he then disconnects his hose and pours in some of the alcohol, thus relieving the ice situation for a short time.

In theory, heating the air is the best plan, but in practice it involves more trouble than the average man is likely to take. The use of alcohol is perfectly satisfactory from an operating point of view, but some convenient and economical provision for injecting it into the pipes should be provided. The objection may be raised that the mixture of alcohol and air may form an explosive compound; but this mixture is made every day and we do not hear of any explosions resulting. It certainly will not increase this danger to provide means of feeding the alcohol regularly into the air line instead of pouring in an excessive quantity and then doing without it for a period.

The accompanying illustration shows a convenient arrangement for feeding alcohol into the air line, which can be built at small expense and regulated to suit the demand. A short piece of 6-inch pipe *A*, capped on each end to make a reservoir, is fastened to a wooden horse *B* by a strap *C;* the reservoir is filled through a valve *D* on the top of the cap. A small pipe at the bottom is provided with a needle-valve *E* to regulate the feed; the valves sold for gasoline torches are suitable for this purpose. As it is necessary to know how fast the alcohol is feeding, means must be provided to observe the flow. A glass like that used in a sight-feed lubricator may be employed, but as this is likely to be broken a better method is to use a petcock *F* as indicated. When this petcock *F* is opened, the drip may be observed and adjusted; then, when it is closed, the alcohol will flow off at one side through the feed-pipe *G*. By using a number of these feeders near the terminals of the branch lines, instead of one large feeder on the main line, some advantages are gained. If this feeder is made of ⅛-inch flexible copper pipe, the connections may be made at any troublesome point without exact pipe fitting, and slight disarrangements will not break the pipe. In the feeder shown, an extra petcock *H* is provided which may be opened when adjusting the drip valve to relieve any air pressure that may accumulate from the leaking of the shut-off valve *J;* otherwise, the unbalanced air pressure may cause the alcohol to drip faster while it is being adjusted than it will when the valve is closed. The small pipe *K* is necessary to maintain the pressure in the reservoir and to admit the air above the alcohol.



FEEDING ALCOHOL INTO MAIN

When it is considered that under bad conditions the machine operators may often waste from 50 to 75 per cent. of their time because of frozen machines, it will be apparent that almost any reasonable expense or trouble that may be taken will be an economical measure if it removes the difficulty. The required amount of alcohol is best determined by test, gradually shutting down the feed to the minimum necessary to prevent freezing. It may be calculated by considering the capacity of the compressor and the degree of humidity, and then allowing about 25 per cent. of alcohol for the water content. Any kind of alcohol may be used. Some other anti-freezing chemicals might be employed, but most of those that are effective have some objection to their use. Any oily substance is injurious to the rubber hose. Alcohol also is injurious, but as it is used only during the most severe weather and quickly evaporates, this objection is not of much practical consequence.

[The above interesting article which we reproduce from *Machinery*, Dec., 1918, seems to invite a word of remark. The use of alcohol for the freezing-up trouble is, as the writer intimates, not infrequent, and the arrangement which he describes seems to be well adapted for the purpose, especially when we are assured that it is an actual success in practice.

The writer, however, does not seem to realize the possibility and the advisability of getting as much moisture as possible out of the compressed air before it is sent into the pipes for transmission. As to getting the intake air as cool as possible there can be no question, but it is intimated in the article that no pains were taken to get the air also as dry as possible, when it is a notorious fact that the driest air that can possibly be found is always saturated and, as we might say, dripping with water, when it has been compressed to the usual working pressure and allowed to cool to normal temperature. When the air is at its highest pressure and by aftercooling is also at its lowest temperature its capacity for moisture will be reduced to a minimum. There must then be a considerable quantity of released water present and this should be separated and drawn off right at the compressor, and then the water trouble will no longer be serious.

DOMESTIC OIL FIRING DEVELOPED IN EGYPT

We reproduce from a recent issue of *The Engineer*, London, some account, with photos, of a successful special oil burner for domestic use which was developed under the pressure of necessity and in an unusual locality.

Egypt, like other countries, has of late been thrown on her own resources, and though she is in the fortunate position of "producer," the fuel problem for domestic purposes has caused considerable anxiety to the responsible authorities.

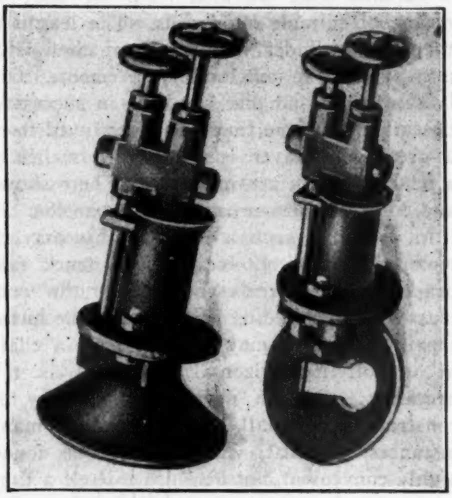
The importation of coal for the civilian population has practically ceased, and without the timely discovery of the Red Sea oil fields, and their development by the Anglo-Egyptian Oil Company, power houses must have come to a standstill. The crude oil is somewhat deficient in the lighter products, but there is a plentiful supply of "mazout," or residues of a heavy viscous nature, and frequent attempts have been made to utilize this heavy oil for domestic purposes without success. Now, Mr. E. C. Bowden-Smith, M. I. Mech. E., of Cairo, informs us that he has recently devised an efficient system of combustion, together with a simple liquid fuel burner, which can be applied to an ordinary kitchen range without structural alteration or interfering with the burning of solid fuel. The essential features are: the use of compressed air as the atomising fluid, induced draught for combustion, the gravitation of the oil, sight feed, and the inability of the burner to choke.

Figs. 1 and 2 are both photographs of the "Scarab" burner, which in this case is provided with a flange for bolting it to a hinged furnace door, and both the oil and atomising fluid, either air or steam, are controlled by regulating wheels. The cast-iron cone is embedded in fire clay inside the furnace. Fig. 3 shows how the burner is attached to the front of a closed kitchen range.

The oil reservoir will be observed raised on a stand, so that a lamp may be set beneath it for initial heating purposes, and the air-supply pipe can be seen attached to the range between the two oven doors. Flexible metallic pipe is used for the connections, as it is of great importance that no uncoupling of nuts and unions should be necessary for cleansing purposes.

The burner itself is of novel but simple construction. It consists of a frame attached to the front of the range, on which is hinged a hollow casing through which passes a pipe terminating in a nozzle for the compressed air. Parallel to this pipe, fixed above the casing, is a similar pipe for the fuel oil, which terminates in a lip precisely over a pin, fixed in the top of the nozzle. The nozzle projects an inch or so into the fire grate, but does not in any way interfere with the burning of solid fuel. A regulating wheel in the burner header controls the oil supply, and in this instance an ordinary 3-8 in. valve (not shown) controls the air supply, as the pressure is constant at 20 lb. It is obtained from the compressed air mains for draining the city.

To start the burner from cold the fuel oil is heated, preferably to 180 deg. Fah. A small fire is made in the grate, of any kindling material. The valves are opened. Oil flows through the upper pipe till it creeps from the lip on the pin, and thence on to the nozzle. The air issues from an orifice in the nozzle, and, meeting the oil at right angles, injects a spray into the fire grate; atomisation and ignition takes place. A fierce draught is induced through the casing, and a continuous flame of dazzling brilliance radiates a steady heat. There is neither smoke nor smell, as perfect combustion takes place, and the only noise is a gentle singing similar to that of a boiling kettle As the grate and fire bricks be-



HEAVY OIL BURNER

come heated the fire gains in strength, and no difficulty has been experienced in maintaining temperatures for roasting and the heaviest day's cooking on the largest range.

The quantity of oil consumed depends upon the fierceness of the fire it is desired to maintain, and varies from .75 kilo (2 lb.) to 4 kilos. (9 lb.) per hour. From the daily records in actual cooking without any attempt at economy it was found at the Kasr-El-Eini Hospital, Cairo, that 32 kilos. of oil would do the work of 80 kilos. of coal, and the figures for the Turf Club, Cairo, worked out at 48 kilos. of oil to 107 kilos. of coal. Therefore, weight for weight, there is a saving of over 50 per cent.

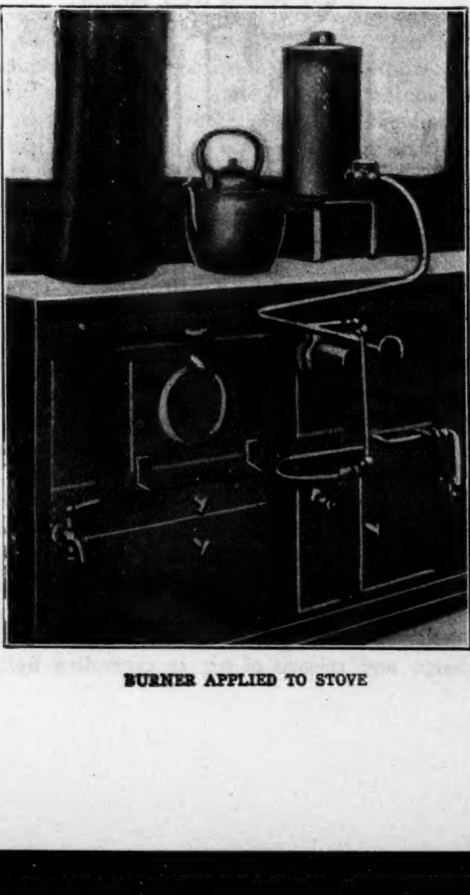
At war prices there is no necessity to lay stress on the enormous saving in the cost of firing. No doubt a kitchen range does not consume coal so efficiently as a steam boiler, but it is obvious this system of oil firing has a very high efficiency. Large burners of this design have also been made for power-house boilers.

The volume of compressed air required for atomisation is by no means excessive. A circular orifice of a certain diameter cannot discharge more than a certain volume of air at a certain pressure. In a small kitchen range, with a working pressure of 20 lb. per square inch, a volume of .119 cubic feet of free air per minute is required. For a large range an orifice discharging approximately .30 cubic feet of free air per minute has been found sufficient. There is little doubt that the induced draught assists atomisation.

CAIRO AIR COMPRESSING PLANT.

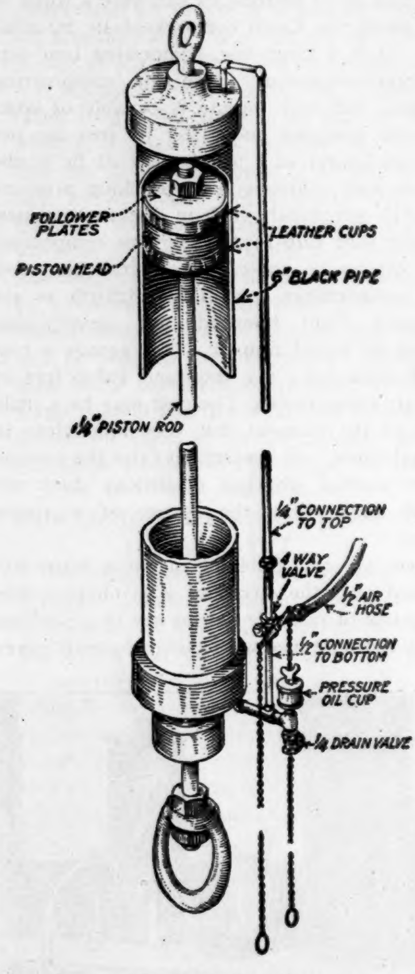
It may be of interest to add here a word or two about the Cairo compressed-air installation. It is a large one, comprising four sets of triple-expansion steam air compressing engines, and each engine is capable of compressing 2,000,000 cubic feet of free air per day (24 hours) at a pressure of 22 lb. to the square inch, which gives a working pressure of 20 lb. per square inch in distant localities. For the year 1916-1917 the volume compressed was 573,240,000 cubic feet of free air, at a total maintenance cost of £E.6.878.976, or six thousand eight hundred and seventy-nine pounds in round figures. This equals a cost of £E.0.012 (3d.) per thousand cubic feet of free air compressed. The cost may be a little more at the moment, but very much less in normal times. At present, to raise the sewage under normal working conditions does not absorb more than the output of a single engine.

There are 28½ miles of cast-iron main distributed over the city, and it is obvious that thousands of rateable houses are in a position to derive the immediate benefit of cheap power



BURNER APPLIED TO STOVE

for combustion, and at the same time reduce the costs of maintenance of the compressed-air installation.

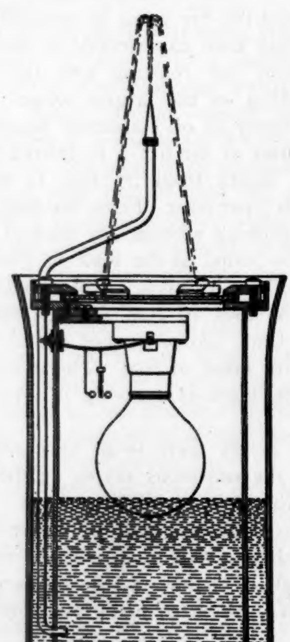


A HOMEMADE AIR HOIST

The cut here reproduced from a recent issue of Coal Age shows a handy air hoist that can be made at almost any mine shop or elsewhere, and it can be employed to good advantage.

The drawing is almost self-explanatory. The hoist cylinder, or barrel, is made of a piece of ordinary 6-in. pipe. The piston is constructed of three disks and two cup leathers faced in opposite directions, the whole being held firmly together between a collar on the piston rod and a nut on the end. The admission and release of air is controlled by a suitable cock operated from the floor by means of suitable hand rods. The length of the hoist cylinder and travel of the piston may be made to suit local requirements. One hoist of this kind that has been in successful operation for some time and has proved itself a great time saver is made with a lift of 4 ft. 6 in. With a 6 in. barrel as here shown and 80 lb. air pressure it will lift one ton.

In operation such a hoist as this may be mounted upon a jib crane or a track suspended either permanently from the roof trusses of the building or from a frame in the repair yard, or it may be hung from a chain or eyebolt if horizontal movement is not necessary. Such a device as this may be constructed at small expense, and in many instances, at least, will not only be found highly convenient, but also prove itself a time saver of appreciable value.

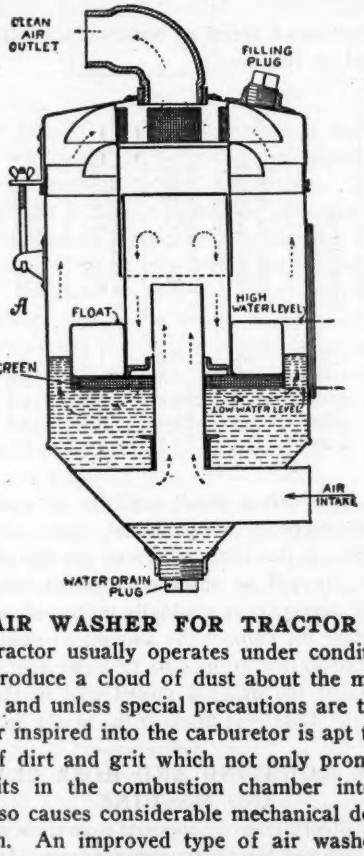


AN AIR OPERATED ELECTRIC FOUNTAIN

The neat and simple electric fountain shown in the sketch might not at the first glance be regarded as a compressed air proposition, but such it certainly is. A 150 watt Mazdo lamp is placed in the upper part of an airtight vessel

partly filled with a liquid, say perfumery, to be sprayed. The tube at the side is open to the liquid near the bottom and its upper end is a nozzle of capillary dimensions. The heating of the air by the lamp develops a certain pressure which acting upon the liquid drives it up the tube and out of the nozzle. When the current is turned off the air pressure falls and the liquid collected at the side returns to the inner vessel through a check valve.

This fountain is the invention of Matt. Luckiesh by whom it was recently patented and assigned to the General Electric Company.



AIR WASHER FOR TRACTOR

A tractor usually operates under conditions that produce a cloud of dust about the mechanism and unless special precautions are taken the air inspired into the carburetor is apt to be full of dirt and grit which not only promotes deposits in the combustion chamber interior but also causes considerable mechanical depreciation. An improved type of air washer is shown in the cut here reproduced from the *Scientific American.*

This is the type in which the air is passed through a water chamber and actually washed before it is sucked into the engine. Of course, water will be used up in this process, so a float controlled stack insures that all air must pass through the water as indicated by the arrows. In addition to the water, the air must pass through screens as well, so the water that may be present in the form of globules is effectively broken up and no dirt can be drawn into the engine. This insures clean, moist air, very desirable for engines using kerosene carburetors, and also reduces scoring of the cylinders and wearing of the rings of the piston. A glass water gage is provided so the operator can make sure there is an adequate supply of water at all times.

AN AIR SCREEN FOR FURNACE WORKERS

Workers tending furnaces, and required to examine the glowing material at frequent intervals suffer a great deal from the heat radiation, and various devices have been tried for minimizing the ill effects. For example, hollow water cooled furnace doors have been tried, but they only afford protection while they are closed. Again, devices have been installed for drawing off the hot air in front of furnaces by centrifugal exhausters placed in front of the furnace opening. An objection to these is that the workers are subjected to great variations in temperature prejudicial to health. A recent article in a German publication states that the most effective device is the fixing immediately behind the furnace door of a narrow oblong nozzle through which cold air is blown upward, thus interposing a screen of relatively cool air between door and furnace. This arrangement is stated to give adequate protection to the workers, and has the incidental advantage that when the doors of the furnace are opened the escape of flames is checked.

GRADING SMALL COAL BY AIR CURRENT

The grading of fine coal by means of a powerful current of air is an interesting departure, which may well have considerable possibilities, especially as the dust taken out by such method will be comparatively free from substances of higher specific gravity of coal.

At a North Country colliery where a grading plant has recently been installed by Messrs. Matthews & Yates, the coal is delivered to the washery by a bucket elevator, and discharged on to shaking screens. The grading apparatus is fixed immediately under the delivery shute of the elevator, the mixed coal being allowed to flow over a hinged weir plate. Im-

mediately under this plate is an orifice through which a powerful current of air is drawn by means of a centrifugal fan. The size of the opening is capable of adjustment by means of a sliding plate. The passing stream of coal is brought nearer to or kept further from the suction by adjusting the hinged weir plate, so that any desired proportion of small coal can be drawn off. A deflecting plate is fitted into the receiver, which serves to throw the larger pieces of coal to the bottom; the fine dust, passing on with the air through the fan, is finally collected in cyclone separators. These separators, which are of the cyclone patent multiple type, are fixed over the briquetting plant, some distance from the washery. The fines are made into briquettes, which is certainly the most satisfactory method of disposing of the fines coal.

The alternative methods of feeding the fines coal, either dry or in the form of slurry, on to the washed coal are at best clumsy and unsatisfactory. Assuming, as indeed is often the case, the whole of the fines made are used for steam-raising at the works (in which case they can only be fired in the form of a semi-wet slurry), their increased steam-raising capacity if fired in the form of briquettes would fully justify the initial capital outlay on the plant. It need hardly be pointed out that fines for conversion into briquettes must be recovered in a dry state.

In the plant under notice the washery is dealing with 1,000 tons of small coal per day of 10 hours. The exhauster is belt-driven, and has an inlet 22 in. in dia., with an outlet 16½ in. by 23 in. It runs at a speed of about 1,100 r.p.m, and is extracting approximately 12,000 cub. ft. of air per min., the total power absorbed being 15 b.h.p.

The coal is graded into three sizes. All above ⅛ in. falls past the opening (No. 1 Coarse). Below ⅛ in. is deposited in the receiver (No. 2 Medium), and the dust deposited by the separator (No. 3 Fine).

We append results of tests made on various different qualities of coal. The first series has been air-graded from South Yorkshire coal, the mixed coal ranging from 0 in. to ¼ in. The results on this sample were as follows:

Test No.	Fan speed r.p.m.	Angle of weir plate with vertical.	Percentage of coal, No. 1 Coarse.	Percentage of coal, No. 2 Medium.	Percentage of coal, No. 3 Fine.	Percentage of loss.
1	1,400	45	69.5	20.6	8.5	1.4
2	2,800	45	61.9	24.4	13.5	0.2
3	2,800	20	49.4	33.1	17.2	0.3
4	3,400	30	34.0	43.0	23.0	—

The second series of tests, on a Welsh coal, varied as follows:

Test No.	Fan speed r.p.m.	Angle of weir plate with vertical.	Percentage of coal, No. 1 Coarse.	Percentage of coal, No. 2 Medium.	Percentage of coal, No. 3 Fine.	Percentage of loss.
1	1,500	45	96.0	1.5	2.2	0.3
2	1,500	20	91.0	5.5	2.8	0.6
3	2,600	20	86.5	9.1	4.4	—
4	2,800	45	89.0	6.3	4.7	—
5	2,900	10	82.5	9.1	8.1	0.3

In each test a small quantity of coal was put through an experimental plant, and the weights of the three different grades of coal noted. It will be observed that the speed of the air current was gradually increased, and by adjusting the damper the amount of small coal removed varied from 4 to 17½ per cent. The sample of the original mixed coal in the last series of tests was from 0 in. to 1⅛ in.

HOSE MOUNTING AND HOSE CLAMPING MACHINE

The illustrations on opposite page show a hose mounting and hose clamping apparatus devised several years ago by and for the use of the Westinghouse Air Brake Company. The company has not heretofore manufactured these devices except for its own needs, but it now has so arranged that they may be procured upon order, either as complete outfits or merely such details as cannot be supplied from existing railroad material. These can be ob-

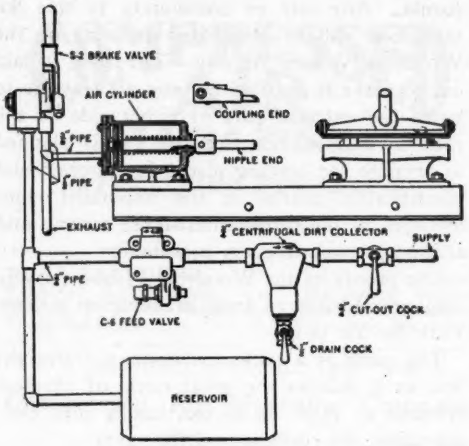


FIG. 1

tained from the company or made to blue prints which will be furnished on request.

HOSE MOUNTING MACHINE.

Referring to Fig. 1 it will be observed that the hose mounting machine consists of a Z-bar frame on which is mounted a hand operated clamp, designed to grip the hose throughout the greater part of its length so as to hold it rigid while the coupling or nipple is being applied; a compressed air cylinder; an operating valve for controlling admission and exhaust of the air from the compressed air cylinder, and accessories including a reservoir, C-6 feed valve and cocks.

The piston rod of the cylinder is adapted to the special heads used for mounting the coupling or the nipple. These heads are removable so that both the nipple and coupling can be mounted on a single machine, although not at the same time.

The operation of the machine is essentially as follows: The hose is placed in the hand operated clamp. The shank end of the nipple or coupling, before being placed on the head, is dipped in rubber cement which acts as a lubricant and also serves to make an air-tight and rigid joint. The clamp is then drawn down to hold the hose rigid; the handle of the operating valve is moved to application position admitting air to the cylinder, causing the piston and rod to move out and forcing the shank end of the nipple or the coupling into the hose. The handle of the operating valve is then moved to release position in which the air is exhausted from the cylinder and the piston and rod returned to normal position. The

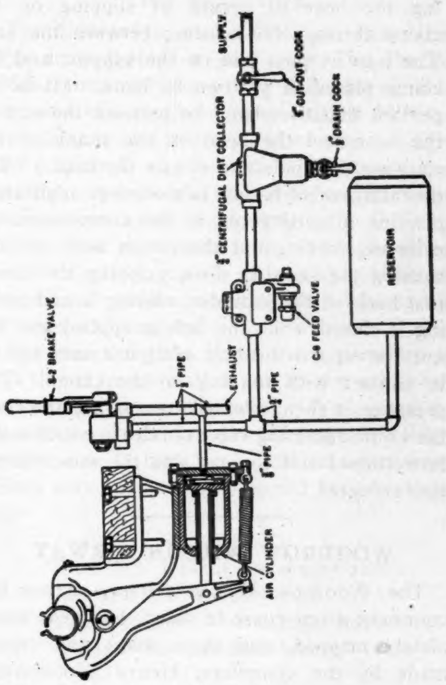


FIG. 2

clamp is then released and raised, allowing the hose to be removed.

When all of the couplings have been applied to one end of the hose, the head on the cylinder piston rod is changed and the nipples applied to the other end of the hose in the same manner.

HOSE CLAMPING MACHINE.

The hose clamping machine shown in Fig. 2 consists of two hardened steel jaws, one of which is movable, a compressed air cylinder, the piston rod of which is connected to the movable jaw, a tension spring attached to the lower end of the movable jaw providing for the opening of the jaws when the air pressure is released, an adjustable support to provide for the various sizes of hose used (to be lowered for the larger sizes and raised when applying the clamps to the smaller sizes. This is important, as the points of the jaws must properly engage the shoulders of the clamp to avoid pinching the hose), an operating valve and a feed valve, together with the usual reservoir and accessories such as cocks, etc.

After the coupling and nipple have been applied, the clamps are first loosely strung on the hose. This is readily accomplished by kink-

ing the hose to permit of slipping on the clamp through the opening between the lugs. The hose is then laid on the support and the clamp placed in position by hand. (It is important that the clamp be between the end of the hose and the bead on the shank of the coupling or nipple and *not on the bead.*) The operating valve handle is moved to application position admitting air to the compressed air cylinder, forcing out the piston and rod and causing the jaws to close, gripping the clamp just back of the shoulder, closing it and holding it closed while the bolt is applied and the nut run up on the bolt until it comes tightly in contact with the lug on the clamp. The pressure is then released by moving the handle of the operating valve to release position, the hose turned end for end and the same operation repeated.

WOODROW WILSON AIRWAY

The Woodrow Wilson Airway across the continent from coast to coast, has been completely mapped, and these maps and report made by the compilers, Henry Woodhouse, president of the Aero Club of America, and Captains Russell Hastings Millward and Robert A. Bartlett, the famous explorer, will be published in the Aero Blue Book issued by the Century Company. The map of the transcontinental airway comprises 17 sections between New York and San Francisco and cost $6,000 to compile, exclusive of printing.

This first transcontinental air-lane was laid out in anticipation of through flights between the two oceans, both for training and military purposes, as well as for ultimate airplane mail delivery. The route was named the Woodrow Wilson Airway after President Wilson signed the $640,000,000 appropriation for army aeronautics last year.

This first transcontinental airway follows very closely the line of the Lincoln Highway between New York and San Francisco, deviating therefrom only where conformation of the country forces road detours from a straight line, which are not necessary, of course, to aeroplanes.

The airway zone extends 40 miles on each side of the airline and touches the most important cities in New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Iowa, Nebraska, Wyoming, Utah, Nevada and California. Any city or community in this 80-mile zone will be designated as being on the Woodrow Wilson Airway. The zone is laid out to make it possible for any air traveler to reach the extreme part of either side of the zone in half an hour's flying. It is planned to arrange for landing places for aircraft and identification marks in the important communities in the direct line of the airway and at the approach to every community.

The proofs of the Woodrow Wilson Airway maps were delivered from Washington to New York by air post.

The route is a curve rather than a straight line, as it follows the great circle of shortest distance as ships do at sea, taking into consideration the curvature of the earth.

The maps of the Woodrow Wilson Airway show not only all transcontinental rail connections, but also the Lincoln Highway, various communities along it, and the location of weather bureau stations, magnetic declinations, etc. A complete chart of all elevations between the two coasts is included.

AIR CLEANERS

Although it has been well known for years that the grit drawn into an engine through the carburetor, with the air required for the combustion of the fuel, is largely responsible for the wear of cylinders and pistons no serious attention has been given to the subject until quite recently, when the Government specified an efficient air cleaner on its war trucks—although such a device hardly existed. This action has had a very salutary effect in a much needed direction. The interest in farm tractors has also had a great deal to do with stimulating the invention of a satisfactory air cleaner, for it was found that the great amount of dust stirred up by a farm tractor in its ordinary work had such a serious effect on the operation of the motor that action by the makers was necessary. Now the problem is being taken up actively, and we may expect that all future farm tractors will be properly equipped, and the device will probably constitute a strong "talking point" in the sale of trucks. Whether it will appear soon on the general (*ne* pleasure) automobile will depend largely on whether buyers insist on it. It certainly would be more desirable than some of the showy accessories now used to attract the attention of the public.—*Scientific American.*

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THE OUTLOOK

Far different is our outlook on this New Year from that of a year ago. The change which came over the world, although so sudden, was still so great as to suggest by contrast a lapse of a century rather than a single year. Then it was war of frightfulness and atrocity unparalleled, and with, as we must now confess, great uncertainty as to the outcome. Now it is peace with no possibility of a renewal of the horrors which did so beset us, but still not without its uncertainties as to the ultimate stabilization.

The one thing we know for a certainty is that things in our nation and in the world can never again be as they were. We cannot go back to the old days or the old ways. We think we are now to have peace and therefore rest. There may be these who would even be singing—

"Now will I bathe my weary soul
In seas of heavenly rest
And not a wave of trouble roll
Across my peaceful breast,"

but nothing of that kind is within the possibilities.

We have entered upon a time of great responsibilities and of great opportunities. Instead of peace and quietness it is a strenuous life that opens before us, and we shall need for it special preparation and adaptiveness. The war it is impossible to forget, and it is difficult for us to avoid still thinking along war lines notwithstanding that these lines have latterly been so diverted from their original parallels.

So far as we must think of providing the weapons and appurtenances of war as still essential for policing the world and for reciprocal protection it will be well to make haste very slowly in view of the changes, the advances if you please, in the means and methods of destruction which the war brought about. Three distinct and most efficient and successful of all human death dealing devices came into action for the first time, and only one of them, the U-boat, gave the world an idea of what it is capable of doing.

Of the employment of blinding, asphyxiating gases in warfare, the second of the novel offensive devices, it is not necessary to speak here. If used in sufficient quantity, and by nations that will not fight according to the rules

of the game, it presents another serious problem.

But the third of the war developments, the airplane as an offensive, is perhaps the most serious of all to deal with. It is easy to believe that it may prove a far greater terror than the U-boat. It is still in process of development and its possibilities still await demonstration. It can go any where and its comings and goings cannot be traced and its location at any instant cannot be anticipated. Its ability to carry enormous weights of high explosives is now almost unlimited and it can operate in masses flying so high as to be little likely to be hit. Our large cities are entirely at its mercy if humanity does not restrain it. To attack naval vessels by this means may be perfectly legitimate warfare, and the question arises at once as to the wisdom of building big ships of war that can now be attacked both from above and from below, and especially the former.

It would seem that at the present time we might be far more profitably employed than in thinking and planning war whether offensive or defensive. Even for the latter service it will be most profitable to forget it until we can get an accurate survey of all the possibilities which the war activities have developed, and in the meantime the arts of peace are open for the profitable employment of many of the war time devices.

FUTURE OF THE AIRPLANE

The following is from an address by G. Douglas Wardrop, editor of Aerial Age, who has recently returned from a trip to the front.

Most people are familiar with the part that areoplanes have played in the war, although their application at the front up to the time of signing of the armistice was nothing compared with the veritable cloud of planes which would have flown over German territory in the Spring of 1919 and literally blown the German from the sky.

The layman has not given as much thought to the future as developments warrant, inasmuch as no work along commercial lines could be done during the continuance of the war. But the following facts are interesting as showing what we may expect within the next year or two, or even within the next few months.

Mr. Wardrop told the guests that at the time he left England he saw a bombing plane capable of carrying a load of 4700 lb. of bombs. He saw another one which was destined for the Berlin route in 1919 which carries 42 passengers.

Trans-Atlantic trips, he says, will be made, without doubt, this coming year, and within the cycle of 24 hours. There is building in Italy an enormous trans-Atlantic cruiser with an engine of 18,000 hp., beside which the 42-passenger plane would look like a pigmy. A cruiser as larger as the Italian cruiser is being built in this country, and it is a sporting competition to see what country will first make the trans-Atlantic record.

A London newspaper was planning to open a Paris office after the war, but has now discontinued these plans, for it will be possible to print a Paris edition in London and deliver it by aeroplane in an hour or two, saving the vast expense of a Paris printing plant.

There is an aeroplane manufacturing company in England that is seeking to contract with the Government for 5 years to carry all first-class mail matter at the present first-class postage rate.

In our own aerial mail program, he said that within a few days after his address was delivered, letters would go from New York to San Francisco within a period of 48 hours.

Another thing which is almost completed at the end of the war and which will, no doubt be a success, is the construction of an aeroplane so that it can hover in one spot or nearly so.

These and many other interesting things that he told show that the last of the three great elements with which man contends has practically been conquered and that it will be but a few years before full commercial developments will have been attained.

Natural gas valued at $9,000,000 was wasted in one year in a certain group of cities and towns in Kansas and Missouri, according to figures compiled by experts of the United States Fuel Administration.

The Traylor Cement Gun Construction Co., Allentown, Pa., organized by S. W. Traylor, president Traylor Engineering Co., will build a plant in France for the manufacture of the Traylor cement gun, to be used in reconstruction work in that country.

GERMANY'S STOLEN CHEMISTRY

The *Mining and Scientific Press* for September 28 contains a breezy and refreshing article by Towne R. Leigh with the above title. He says: "When we recall that Samson slew a thousand Philistines with the jawbone of an ass, we intuitively wonder how many he would have slain if armed with the jawbone of a German propagandist, according to whom all things were made by Germans, and without whom was not anything made that was made. . . . It is time to prick the inflated bubble of Germany's chemical reputation. Glancing down the index of a leading chemical textbook, my eye rests upon the word 'Law,' followed by a list containing 21 fundamental laws by which the science of chemistry is governed. There I see the names of Avogadro, Boyle, Charles, Dalton, Dulong and Petit, Faraday, Gay-Lussac, Henry, Lee Chatelier, Mendelejeft, down to van't Hoff—but nowhere do I see the name of a German."

A LAUNDRY DRIES FRUIT

Since it was discovered that the drying facilities of the laundry could be utilized for drying vegetables and fruit, Manager Jay Davison, of the Northfield Co-operative Laundry, has been swamped with this extra business, which means much extra night work. The vegetables and fruit handled were principally corn, beans and apples. Everything is prepared before it is brought to the laundry, where it is placed on large trays holding about ten pounds each. The capacity of the dryer is about 150 pounds. The trays are placed in the dryer at night and removed in the morning. Steam must be kept up for a while during the evening, and the caretaker must be on hand for a few hours to look after the fruit or vegetables, so they will dry properly.

JACKHAMERS CUT AN OLD PAVEMENT

A trench for a new street railway track in Chicago was recently cut through an 8-in. concrete base at the rate of about 200 ft. per day. The plant and force employed consisted of a portable drilling outfit, a revolving steam shovel, and two gangs of jack and bar men. The cut was 20 ft. wide along the center of the street, and was made after the wood-block paving had been removed.

A portable air compressor, operating four jackhamer drills, led in the work. Holes about 6 in. apart and 1 in. in diameter were drilled through the base. First, a row of holes was drilled on each side of the cut; then, transverse rows, 6 or 7 ft. apart were put through the strip to be removed. Two gangs of bar and jack men followed the drillers, breaking up alternate 75 to 100 ft. sections of the slab. Each gang broke out the concrete in transverse sections, corresponding in width to the space between the transverse rows of drill holes, and threw the fragments behind.

By use of two or three ratchet jacks with a hold under the edge, the base slab was lifted until it cracked into pieces of one or two square yards, with smaller pieces. Men with bars pried the slabs apart, and others using heavy two-handed sledges broke the larger pieces into sizes which would pass a ½-cu. yd. steam-shovel dipper. Pieces which failed to break from the edges of the cut were wedged free with steel points sledged into the drill holes. The steam shovel followed the rearmost breaking gang and loaded the broken concrete into dump wagons for disposal. The work was done for the Chicago surface lines.—*Eng. News-Record.*

CROSS COMPOUND COMPRESSORS ON LOCOMOTIVES

The following is an abstract of a report prepared by a committee of the National Air Brake Association and presented at the recent annual meeting. It will be seen that it deals exclusively with type of compressors attached to steam locomotives for air brake service.

LOCATION AND INSTALLATION

Cross compound compressors should always be located on the left side, forward of the staybolts. While the design of the locomotives will to a certain extent determine the exact location, a place entirely below the running board and as near the rear of the boiler barrel as possible is to be preferred. A large opening and free passage strainer should be installed in a vertical position and secured to a substantial bracket. It should be located so as to be free from dirt thrown up by the driving wheels and where it will not be exposed to escaping steam. The two suction openings from the compressor should be piped together with 2 in. pipes and a pipe of similar size then extended to the strainer.

The oil pipe connection to the steam pipe should be between the main steam valve and

governor. With a two-compressor installation difficulty is sometimes experienced in lubricating the steam ends of both compressors, due to unequal distribution of oil. To facilitate this the 1½ in. main steam pipe should enter horizontally into the side of a 1¼ in. by 1¼ in. by 1½ in. horizontal tee, located adjacent to and above the compressors. From this tee two 1¼ in. branch pipes of equal length should extend to the compressors.

LUBRICATION.

When starting the compressor the piston rod swabs should be lubricated with valve oil, the throttle opened gradually and the compressor run slowly until all condensation is worked out of the steam cylinders, then the drain cocks should be closed. All drain cocks are to be opened, and left so, when compressor is stopped at terminals. While the compressor is yet working slowly, 10 to 15 drops of oil should be fed to the steam cylinders and 8 to 10 drops to each air cylinder. After obtaining about 40 lb. pressure the throttle can be opened.

The air cylinders should be lubricated regularly, four to six drops, how often depending on the service, but never over six hours apart in heavy freight service, and especially just before starting down a mountain grade. With cab air cylinder lubricators, which are superior to the hand oilers, never attempt to adjust to feed continuously, as the slowest possible regular feed will be excessive.

There has been considerable criticism regarding the use of superheat oil in the compressor air cylinders, the general impression being that it is too heavy, tending to more quickly clog the passageways and packing rings. While it is conceded that better results may be obtained with Perfection valve oil, yet where the special 54 air strainer is employed no trouble is experienced from the use of superheater oil, thus indicating that the gumming with it is mainly due to dirt.

Dirt entering the air cylinders destroys lubrication and increases the wear of packing rings and cylinder walls. The dirt and worn-off metal form the hard gum so frequently met with; hence, the exclusion of dirt will improve the lubrication and reduce the wear and gumming.

COMPRESSOR LAUNDRIES

A very effective and economical way to remove this deposit is by means of the compressor laundry, which should be used every three months or longer, depending on the service and protection afforded against dirt. Compressor laundry outfits consist in general of an enclosed tank mounted on wheels, for a lye solution, a steam coil inside the tank and suitable pipe connections to join the tank to the suction and discharge openings of compressor. The solution should consist of about one lb. of concentrated lye to one gal. of water, and should be kept hot by steam circulating through the coil while the compressor is being laundered.

[A description of compressor laundries of the type here referred to will be found in *Compressed Air Magazine*, August, 1918, page 8846,—Ed. C. A. M.]

The length of time the compressor should thus operate depends on its dirty condition, but usually from two and one-half to three hours gives the best results. After the compressor has been thoroughly cleansed the tank connections should be removed. Clean water (hot water is preferable) should then be worked through the air cylinders for several minutes, discharging into the pit, to insure all of the solution being removed, after which the compressor should run idle until all the water is worked out of the cylinders. The air cylinders should then be well lubricated, the strainers applied and the discharge pipe connected. If soft packing is used the air end may need to be repacked. A solution of about 10 gal. will be sufficient to cleanse about five compressors.

Insufficient lubrication, especially in the steam end of the compressor, is one of the most common causes for the compressor running slow. On roads where valve oil seems to be at a premium, either by an oil schedule or otherwise, the air compressor is usually the part that is stinted to make an oil record. At the normal cost, of about 55 cents per gal., for oil it will cost 5 cents per 16-hour trip to properly lubricate both ends of the compressor.

Other causes for the compressor running slow are worn packing rings in the high-pressure air cylinder or clogged passages in the air cylinders. No trouble will be experienced with the latter if the compressor laundry is

used as herein recommended. The compressor will pound or make irregular strokes from causes such as main steam valve dry, packing rings in low-pressure air cylinders badly worn, piston rod packing blowing, clogged air passages, air valves with improper lift or leaking and too much oil in the steam cylinders in combination with close throttling by the steam valve or governor.

The compressor will give good service when the low-pressure air piston packing rings are worn until 3-32 in. to 5-32 in. open. The latter should be the limit.

A slow upward stroke of the low-pressure air piston may be caused by a restricted air passage between high and low pressure air cylinders, or top steam cylinder gasket leaking to the top side of high-pressure steam piston, or high-pressure air piston packing rings leaking, though if the latter were at fault the low-pressure air piston would move slowly in both directions. If the high-pressure air piston makes a quick downward movement and the low-pressure air piston a quick, upward movement, the cause may be on account of a lower intermediate valve leaking or held off its seat. If the quick movements of the pistons mentioned are in the opposite direction than stated, the cause may be from an upper intermediate valve leaking. If the high-pressure air piston only makes short strokes, and compressor will not maintain more than 45 to 60 lb., it indicates discharge passages badly clogged, or final discharge valve leakage.

When a compressor gradually keeps reducing in efficiency until it does not maintain standard pressures under relatively favorable conditions, the trouble is usually due to worn and leaking high-pressure air piston rings. Under these conditions the low-pressure air piston will be working against more than its normal pressure. Low speed can also result from steam cylinder gasket leakage, and if leaking between ports of high and low pressure cylinders, or between low-pressure cylinder and exhaust, it can be located by a continuous blow at the exhaust, providing the exhaust pipe is disconnected close to compressor and the latter run slowly. If the compressor has been maintaining standard pressures, and in a relatively short time does not, the trouble is undoubtedly due to some foreign substance lodging under an intermediate or discharge valve, thereby causing serious leakage. Such foreign substance can at times be removed by closing compressor throttle and brake valve cut-out cock, draining all pressure from main reservoirs, after which run the compressor fast for a few minutes. After the main reservoir pressure is restored, open brake valve cut-out cock.

AN A. C. MOTOR AND A LITTLE OIL

A stone cutter, who used considerable compressed air for pneumatic hammers, had the compressor overhauled and a new automatic starter for the electric motor installed. The motor was a single-phase 220-volt self-starting squirrel-cage clutch type, belted to the compressor. In this type of motor when the circuit is closed the rotor starts to revolve, and when it has attained sufficient speed the clutch takes hold and starts the compressor. When tried for the first time the motor started, but when the clutch took hold the motor stalled because the compressor would not start. Several men tried to help by turning the flywheel, but without success, and unless the man operating the switch was very careful the fuses would blow.

As the starting box was the only new part (the motor having driven the compressor for over two years previously), naturally it was thought to be the cause of the trouble. An ammeter and voltmeter were connected in the circuit and showed the motor to be overloaded when starting, but after the compressor was started the motor was well able to carry its load.

A clicking noise heard at the back of the compressor proved to be coming from the unloading device, supposed to prevent the air pressure from rising in the compressor until the motor was at full speed, but it was not working properly. After this device was oiled and adjusted, the motor started easily every time.—*A. Rathron, in Power.*

GAS TRANSMISSION IN WELDED PIPES

By W. M. Henderson

The distribution of gas is usually accomplished by large mains under low pressure, though the rapid development of rural territory and the spreading out of municipalities have prompted the adoption of high-pressure transmission and distribution to quite an extent.

The usual practice is to distribute gas through cast-iron pipes under a pressure varying in different communities, but generally about six or eight inches of water. Higher and lower pressures are occasionally varied.

The distribution system is laid out originally with a view to maintaining a constant pressure throughout the system. This is accomplished by installing large enough pipes from the works outlet to a point beyond the center of distribution, radiating out from which are pipes of reduced size. These pipes are connected wherever possible; the ideal system in this way would have no dead ends. It is always the object of the engineer in designing the distribution system to build with the idea of taking care of the peak-hour demand. That is, the pipes must be of such size as to care for the maximum momentary demand without apparent drop in pressure. This point is quite important, for in some communities where the load is entirely domestic, there is a great "pull" between 11.30 a. m. and 12 m. or 5 p. m. and 6 p. m. The size of main pipes must be such that they will supply this demand without a pressure drop so great as to affect the gas-consuming equipment.

LUBRICATING AN AIR COMPRESSOR

The two letters following we reproduce from a recent issue of *Power*. The second letter in which the writer found that two drops of oil per minute gave satisfactory results, suggests an inquiry as to why he did not try one drop a minute.

After reading some time ago that water was good for helping to lubricate the cylinder of an air compressor, we decided to try it. We had just installed a compressor and were having considerable trouble with the valves carbonizing and getting hot.

We connected an oil pump to the air cylinder, filled it with water and fed a few drops of water per minute to the cylinder.

We have had no trouble with the valves carbonizing or getting hot since and it is a great saving in oil. The compressor works as well with one-third less oil.

Manassas, Va. R. A. WILLIAMS.

A 20x16-in. air compressor running at about 155 r.p.m. had been getting an unknown quantity of oil, but wishing to know how little would be enough, I adjusted the feed to barely two drops per minute and after running about a week inspected the cylinders, which I found to be thoroughly lubricated and in good condition. The gravity of the oil used was 27.3 Baumé.

That the compressor had previously been getting too much oil was evidenced by the fact that we recovered about ten gallons from the receiver. R. McLAREN.

St. Catharines, Ont., Canada.

THAWING DYNAMITE

Dynamite is both combustible and subject to explosion from a heavy shock or concussion. Such being the case, it would not make safe kindling wood for the kitchen stove. Neither would a man drop it from a second-story window on the pavement any sooner than he would his watch or his eye glasses. As a rule, any ordinary heat that does not injure the human body is perfectly safe from the dynamite viewpoint. The low freezing dynamites are not affected by cold at a temperature above that at which water freezes, but will chill at lower temperatures.

When frozen it is more insensitive and may give trouble by failing to explode; hence it should be thawed before using. Several instances have been known where frozen dynamite has been laid on top of a hot stove or in the oven with disastrous results to the stove, and somewhat damaging effects on the unenlightened individual who attempted to do the thawing in this manner.

Probably the best method of thawing small quantities is to have two metal vessels, one fitting loosely into the other, or a specially constructed double compartment kettle. The outer vessel or compartment should be filled with warm water, while the dynamite is placed in the inner compartment, where it is dry, and allowed to thaw. The practice of placing the dynamite cartridges themselves directly in the warm water is questionable, for instances have occurred where some of the explosive ingredient has been leeched out—*Pit and Quarry.*

JOINTS IN HIGH PRESSURE PIPE

The only successful type of joint for high pressure is no joint at all. That is, welding by oxy-acetylene the butt ends of the wrought-iron pipe. This idea was developed by Mr. L. B. Jones of this company,* a little over five years ago; today it is *exclusively used and has proved itself so satisfactory that no substitute is even given a thought.*

The pipe for welding is purchased with chamfered ends, and so when butted together a V is formed. The welder works on top of the ground alongside of the trench. With the oxy-acetylene torch and a stick of wrought iron he proceeds to heat the pipe-ends and melt the stick of iron which builds up on the pipe ends. He goes completely around the pipe; usually the pipe is turned as it is more convenient to make the joint upside-down. Practice in this work only makes perfect. The things to avoid are learned by observing cause and effect and very soon the welder becomes perfect and joints are made as strong as the pipe itself.

The entire system of gas distribution at the recent Panama-Pacific Exposition in San Francisco was through pipes with welded joints. The gas supply to the Redwood District is through an 8-inch high-pressure line thirty miles long, every joint of which was welded. Between Santa Rosa and Petaluma there is over twelve miles of welded pipe. In Fresno, Sacramento, San Rafael, Oakland and San Francisco every bit of high-pressure laid in recent years has been welded.

NOTES

A prominent tank manufacturer passed a compliment to the durability of wood in tank work, by advising metal tanks for temporary use and recommending cypress tanks for permanent structures. It used to be that we associated permanence with metal, but now we are learning that metal has its life limits and often wood is more durable.

A postal tunnel about 1¼ miles long, from Grand Central Terminal to Pennsylvania Terminal, New York City is contemplated by Postmaster General Burleson who estimates the cost of construction at $1,125,000 and has asked for an appropriation to build and equip it.

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*Pacific Gas & Electric Company.

Steel smokestacks 12 ft. in diameter and 125 ft. high in a Chicago power plant were razed by cutting through the base, just above roof level, with the oxy-acetylene flame and then jacking at one side until they fell over. The hopper bottoms of the steel coal bins were also cut off by the flame and allowed to fall to the ground; the headers of the 500-hp. water tube boilers were cut off in the same way and jacked out. The 35-ft. diameter flywheels were easily cut up and their 36-in. shafts were cut into three pieces.

The utilisation of water power in France has increased by more than 50 per cent. since the commencement of the war, and by the end of 1921 the available water power will be double the amount installed at the outbreak of the war.

The Allied countries produce most of the gold of the world, the British dominions and the United States contributing about 85 per cent. of the total. Russia normally yields 5 per cent.

I am as adverse to "scientific management" as I am to scientific employment. The whole theory of scientific management is essentially foreign to the human element and is destructive of individualism and therefore of propress. Pride of work, not pressure, keeps production at top speed. I hold it to be inhuman to work men as though they were machines; in addition to being inhuman it is bad business.—John North Willys, President of the Willys-Overland Company.

The astonishing increase in the production of aluminum can be judged from the fact that while the world production in 1913 was 68,000 tons, experts estimate the production for 1917 at 136,000 tons, for 1918 at 230,000 tons, and for 1920 at 350,000 tons.

The greatest advantage claimed for the cost plus system is that on urgent work it permits work to be started without waiting for the plans to be compleetd, thus effecting a great saving in time, and also probably in cost, as an efficient contractor, working with an architect or engineer, can no doubt make suggestions that will save money as well.

In the aircraft standards published by the International Aircraft Standardization Committee while it was sitting in Washington last winter, all dimensions, stress allowances, etc., are given in both inch and metric units, but whereas many of the English dimensions are in round figures all the metric dimensions are in three-place decimals.

A channel tunnel scheme is in project for Japan. Permission has been applied for to construct a tunnel under the Shimonoseki Straits, connecting Kyushu with the mainland. The length of the tunnel would be about six miles.

The Australian chemists claim to have discovered a process for the manufacture of a fast dye from a by-product of eucalyptus oil distillation, known as "black-water." Nearly eighty colored dyes have already been produced by the experiments and patents are being applied for.

We have adopted in our own correspondence a little piece of economy which may appeal to others. On letters to which no reply is necessary, save as a matter of courtesy, we write "National Economy—No acknowledgment of this letter is expected." Every one knows how much time is wasted and paper and stamps used on unessential correspondence. By this means some economy is effected. We suggest that large offices might use printed slips or rubber stamps for the same purpose.—*The Engineer.*

Not only the plurality but also the majority contributor to the world's supply of petroleum is the United States, which furnished 64.74 per cent. of the estimated total for 1917. The others were: Russia, with 13.26 per cent.; Mexico, 11.37; Dutch East Indies, 2.74; Rumania, 2.08; India (Burma and Assam), 1.61; Persia, 1.32; Galicia, 0.947; Japan, 0.615; Peru, 0.511; Trinidad, 0.303; Germany, 0.189; Argentina, 0.170; Egypt, 0.094; Canada, 0.037; Italy, 0.002; and other countries, 0.006.

An interesting war-time development in connection with gas has been the installation of toluol-recovery plants in large municipal gas plants for the recovery of toluol from the oil in the course of gas manufacture, thus adding to the supply of toluol contributed by the by-product coke oven. It is a striking coincidence that both coal and petroleum furnish the basis for the manufacture of one of the most effective explosives known.

The flow of gas from the natural gas wells at Nuengamme, near Hamburg, has ceased altogether, after the pressure has been getting lower each month. This marks the end of one of the richest sources of income of the city of Hamburg, which controlled this gas well, the revenues each year amounting to about $500,000. The supply of natural gas in Germany as a whole is of course negligible, there being very few natural gas wells, the one near Hamburg being about the only one that could be said to be practically useful. This source of natural gas was particularly important during the war, owing to the shortage of coal.

The quantities of pulverised coal used in the United States annually in various manufactures are as follows:—In the cement industry, 6,000,000 tons; in the steel and iron industry, 2,000,000 tons; in the production of copper, 1,500,000 tons, and in the generation of power, 100,000 to 200,000 tons. To attain success the coal must be dried, crushed and pulverised until 95 per cent. will pass through a 100-mesh sieve, having 10,000 openings to the square inch. A cubic inch will contain over 200,000,000 particles, none of which will be greater than one-hundredth of an inch cube, and a large percentage less than one six-hundredth of an inch cube.

News of the rapidly increasing use of pneumatic riveting tools comes from both Clyde and Tyne areas. It has been one of the most marked features of the work of the Clyde shipyards during the last two or three months, and by the end of the year the extended use of these important tools will be reflected in the greater output of vessels on both the upper and lower reaches of the river. Most of the yards have now installed the necessary compressing apparatus. Thanks to the new arrangement for levelling up the wages of the men while they are learning to operate the machine, there has been no scarcity of willing workers. One important firm recently completed arrangements for doubling

its present holding of pneumatic tools, and expects no difficulty in securing the necessary number of riveters.—*The Engineer.*

Powdered coal constitutes 85 per cent of the fuel used in calcining 93,500,000 barrels of cement made in America during 1917. This industry alone consumed 5,000,000 tons of powdered coal last year.

The tallest flag-pole in the world was raised at Camp Lewis on October twelfth, the pole measuring three hundred and forty-six feet from end to end. It was set in a concrete base sunk twelve feet in the earth. Engineers at Camp Lewis took a great interest in the event, as getting this pole into place and hoisting it is considered quite an engineering feat.

A new way of drying fruit juice, blood and eggs, called the Krayseska method, was demonstrated before the food authorities of Berlin and was found to be worth exploiting to a large extent; it was announced that plants of this type for treating about 140,000 eggs a day would shortly be erected in Berlin and Bucharest. The drying is done in a large iron cylinder five meters in diameter, in which a pair of big metal wings rotate rapidly, driven by a steam turbine. The fluid is lashed to foam, and dried by a current of hot air that is continually passing through the cylinder. The dried products go through no chemical change, and are directly soluble in water. They are in the form of a powder, which will keep for a long time and can of course be transported with great economy.

It is stated that the Medical Research Board of the Division of Military Aeronautics, in the U. S. A., has found a substitute for glass for pilots' goggles. The substance is hard, non-inflammable, and practically non-shatterable, and should be serviceable for windscreens and for "lights" on enclosed cars.

A new driving belt leather substitute is now being manufactured in Austria. This article, which is called driving-belt leather substitute or iron leather (according to an announcement of the Treasury to the Customs), is made of double iron wire spirals twisted together and in part slightly copper-plated by a chemical process. One sample is about 10 cm. broad. Another sample is of wire gauze strips interlaced with one-ply and two-ply paper yarn, partly with single and partly with double threads. It is bound at the edge with paper-yarn, then strongly impregnated with tar asphalt and flattened out between rollers. A third sample is bound with iron wire spirally twisted.

Some particulars of the paper substitute driving-belts, which are now being introduced into German workshops, are given in the *Bulletin des Usines de Guerre.* The paper is cut into narrow bands which are then spun. The belts are made by weaving or braiding. Woven paper belts are of two kinds—paper fabric and paper thread belts, the former being the more frequently used. The fabric is first cut into bands 40 m. long, which are subsequently made up according to the desired width and thickness. A core of strengthening material is interposed, either cotton or sheet metal, though more recently these cores have consisted of paper thread and metal wires interwoven. The core is surrounded with the paper strips and the whole sewn with strong thread. Belts so prepared are said to be very flexible and to wear satisfactorily. Woven paper belts have a tensile strength of from 100 to 125 kilos. per centimetre of width.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

OCTOBER 8.

1,280,642. TUNNEL-DRIER. George Hillard Benjamin, New York, N. Y.
1,280,672. AIR-HEATING APPARATUS. William F. Cox, Danville, Va.
1,280,767. DEVICE FOR WITHDRAWING LIQUID FROM CONTAINERS. George W. Lake, Rumford, R. I.
1,280,770. FLUID-OPERATED GEAR-SHIFTING MECHANISM. Laurits A. Laursen, Cornell, Wis.
1,280,780. PNEUMATIC CONVEYOR. Guido E. Lob, Chicago, Ill.
1,280,784. FOUNTAIN. Matt Luckiesh, Cleveland, Ohio.
1,280,811-2. PULSATION-PREVENTING APPARATUS FOR CENTRIFUGAL COMPRESSORS. Sanford A. Moss, Lynn, Mass.
1,280,843. PULSATION-PREVENTING MECHANISM FOR CENTRIFUGAL COMPRESSORS. Richard H. Rice, Lynn, Mass.
1,280,863. PNEUMATIC COTTON-GIN. Cecil L. Saunders, Cleveland, Ohio.
1,281,005. SOOT-BLOWER. Samuel J. Herman, Detroit, Mich.
1,281,041. AUTOMATIC AIR-CUSHION. Geo. William MacKinnon, Boston, Mass.

1,281,068. AIR-PUMP. Daniel H. Prutton, Cleveland, Ohio.
1,281,072. PNEUMATIC PUMP. Homer S. Rogers, Milwaukee, Wis.
1,281,083. MOLD-LOADING DEVICE. Robert E. McCauley, Pittsburgh, Pa.
1,281,216-7. METHOD OF AND MEANS FOR PREVENTING PULSATIONS IN CENTRIFUGAL COMPRESSORS. Christopher A. Schellens, Marblehead, Mass.

OCTOBER 15.

1,281,297. AIR-BRAKE ATTACHMENT. Frank W. Cox, Bullsgap, Tenn.
1,281,345. BLOW-TORCH OR FIRE-POT. Maurice Goldberger, Fort Wayne, Ind.
1,281,431-2. ELECTROPNEUMATIC BRAKE. Walter V. Turner, Wilkinsburg, Pa.
1,281,433-4-5-6-7. FLUID - PRESSSURE BLAKE. Walter V. Turner, Wilkinsburg, Pa.
1,284,490. COMPRESSED-AIR ENGINE. Milo R. Billado, Jericho, Vt.
1,281,495. AUTOMATIC CAR AIR AND ELECTRIC COUPLING MECHANISM. William P. Bovard, Mansfield, Ohio.
1,281,597. EXTRACTION AND RECOVERY OF VAPOROUS AND GASEOUS CONSTITUENTS FROM COAL-GAS. Rudolf Lessing, High Holborn, London, England.
1,281,618. AIR-MOTOR. Charles McGregor, Derry, N. H.; Jennie H. McGregor administratrix.
1,281,667. DRYING-MACHINE FOR FIBROUS MATERIALS. Frederick G. Sargent, Westford, Mass.
1,281,674. AIR-BRUSH. Paul Seweryn, New York, N. Y.
1,281,801. FLUID-PRESSURE BRAKE. Geo. MacLoskie, Erie, Pa.
1,281,816. AIR - DIFFUSING APPARATUS. Carl H. Nordell, Milwaukee, Wis.
1,281,881. VACUUM-SEPARATOR. Harry A. Thuneman, St. Louis, Mo.
1,281,966. VACUUM - CONTAINER. Payson Irwin, Stamford, Conn.
1,281,972. ROTARY COMPRESSOR AND EXHAUSTER. John Johnston, London, England.
1,281,974. AIR-CHECK VALVE. Fred A. Kaeding, Somers, Mont.
1,281,995. CENTRIFUGAL COMPRESSOR. Sanford A. Moss, Lynn, Mass.

OCTOBER 22.

1,282,065. CENTRIFUGAL FAN FOR BLOWERS. John Froelich, St. Paul, Minn.
1,282,093. DESICCATION PROCESS. Frederick William Lietzow and Oscar Frederick Fleischer, Chicago, Ill.
1,282,120. FLUID-PRESSURE-TESTING MACHINE. Clarence L. Patterson, Detroit, Mich.
1,282,130. ELECTROPNEUMATIC BRAKE MECHANISM. James Richard Sloan, Howard F. Perry, and Ira V. Goodman, Altoona, Pa.
1,282,152. FLUID-OPERATED LATHE. Henry E. Warren, Ashland, Mass.
1,282,232. OIL-BURNER. Granville A. Humason, Houston, Tex.
1,282,243. ELECTRIC AIR-HEATER. Frank Kuhn and Jay A. Hand, Detroit, Mich.
1,282,345. AIR-FILTER. Frederick William Rogers Williams, London, England.
1,282,372. DRY-VAPOR GENERATOR. Alfred H. B-Roberts, Los Angeles, Cal.
1,282,416. BLOWPIPE AND CUTTING-TORCH. John Harris, Cleveland, Ohio.
1,282,444. PNEUMATIC ACTION FOR PLAYER-PIANOS. Frank G. Lynde, Newark, N. J.
1,282,477. VACUUM LIFTING-MACHINE. Carlton L. Smith, Saginaw, Mich., and Oscar I. Lewellyn, Kokomo, Ind.
1,282,506. AIR-PUMP ATTACHMENT FOR AUTOMOBILES. Chester R. West, Madison, Ga.
1,282,514. VACUUM - BOTTLE. Albert E. Wooden, Waterbury, Conn.
1,282,548. ELECTRIC VACUUM-CLEANER. Frank C. De Reamer, Schenectady, N. Y.
1,282,595. FLUID - COMPRESSING APPARATUS. Gottdank L. Kothny and Robert Suczek, Philadelphia, Pa.
1,282,623. METHOD OF AND APPARATUS FOR CASTING CHARGES FOR PROJECTILES. Percy G. Paris, Bethlehem, Pa.
1,282,639. CENTRIFUGAL PUMP, BLOWER, AND EXHAUSTER. George Richard Schueler, Kingston-upon-Hull, England.
1,282,675. RELEASE-VALVE. Oliver Joseph Cantrelle and George Alexander, New Orleans, La.
1,282,686. METHOD OF DESICCATING AIR FOR BLAST-FURNACE USE. Leon Goldmerstein, (now, by judicial change of name, Leon Cammen,) New York, N. Y.

OCTOBER 29.

1,282,771. APPARATUS FOR DRYING MATERIALS IN SACKS OR SIMILAR VESSELS. Hans Peter Dinesen, Herlov, Denmark.
1,282,802. GAS-BURNER. Heinrich J. Freyn, Chicago, Ill.
1,282,822. TUNNEL-DRIER. Gordon Don Harris, Bayonne, N. J.
1,282,841. FLUID-MOTOR. Charles A. Iles, Marion, Ohio.
1,282,881. PNEUMATIC DILATOR. John T. Landis, Nashville, Tenn.
1,282,907. LIQUID-FUEL BURNER. Daniel E. Miess and Alvyn R. Miess, Glendale, Cal.
1,282,928. DRILL. Ralph S. Peirce, Hinsdale, Ill.
1,282,963. METAL - CASTING APPARATUS. Fred Shroder, Chicago, Ill.
1,282,977. EJECTOR APPARATUS. Robert Suczek, Philadelphia, Pa.

1. The method of raising the pressure of elastic fluid, which consists in expanding an elastic motive fluid, entraining therein the elastic fluid whose pressure is to be increased, compressing the mixture of motive and entrained fluids by conversion of velocity into pressure, cooling said mixture while compressed, in a second stage expanding motive fluid, entraining therein said cooled compressed mixture, and compressing the resultant mixture by conversion of velocity into pressure.

1,282,978. CONDENSATE AND AIR REMOVING APPARATUS. Robert Suczek, Philadelphia, Pa.
1,282,980. PNEUMATIC MATTRESS. Nicholas M. Takach, Bridgeville, N. Y.
1,282,997. BLOWPIPE. Emile Waldmeier, Gulfport, Miss.
1,283,027. BLOWER FOR HORNS. George A. Arnold, Boston, Mass.
1,283,048. SOOT-BLOWER FOR WATER-TUBE BOILERS. John E. Bell, New York, N. Y.
1,283,097. AIR-BRAKE FOR AUTOMOBILES. Wiley Eugene Daniel, De Leon, Tex.
1,283,129. WINDMILL OR WIND-MOTOR. John T. Fisher, East Cleveland, Ohio.
1,283,144. PNEUMATIC SHOE-PRESS. John R. Gammeter, Akron, Ohio.
1,283,269. VACUUM-ERASER. Andrew D. Nichols, Harlowton, Mont.
1,283,298. SUCTION - CLEANER. Frank J. Quist, Worcester, Mass.
1,283,341. PNEUMATIC UPPER-LEATHER-CUTTING MACHINE. Michael J. Sloan, Binghamton, and Joseph L. Sloan, Endicott, N. Y.
1,283,416. AIR-COMPRESSOR. Paul Kuehn, Detroit, Mich.